The Pennsylvania Schuylkill Valley Railroad Tunnel at Phœnixville.*

BY M. VAN HARLINGTON.

Tunneling may be considered to be a branch of business by itself, but at the present time all civil engineers are supposed to know something of this branch of their profession, which being understood, it is not necessary for me to go into the history of tunneling, as the object of this essay is to give a short description of the one lately built near Phœnixville on the Schuylkill Division of the Pennsylvania Railroad.

This tunnel is cut through a ridge of hills which runs nearly parallel with the Schuylkill river, and is in the same hill through which the old Phœnixville Tunnel was cut by the Reading Railroad in 1835—1837, and enlarged for double track in 1858—1859, the new tunnel being nearly at right angles to the direction of the original one, but about half a mile further west.

In order to make this tunnel as short as possible, advantage was taken of depressions on each side of the hill, by which means the approaches as well as the tunnel itself were shortened.

Work has begun on the approaches in February, 1883, and pushed with vigor, there being 71,614 cubic yards of material to be moved before the headings could be started. This material was taken out in benches, as many as five at each end being in operation at one time. Eight foreman, 151 men, and 36 horses, were the average force engaged upon this work.

Towards the first day of June it was determined to sink at once for a heading, the subject of sinking a shaft being abandoned, for the reason that the time required for this could be more profitably employed in sinking at the portals, so that work could be pushed in the headings at the same time the approaches were being taken out.

By this means work at the south heading was started June 20th, 1883, and at the north heading August 5th, or about the time it was estimated a shaft could be sunk to the level of the heading.

Work in these headings was pushed so rapidly that by the time the approaches were out the headings had met, or, in other words, by the 12th of August, everything was ready to begin taking out the full section of the tunnel.

The headings were holed in 120 working days, the average daily progress being 6 feet, the total cubic yards of material moved in this time being 4,681, or about 39 cubic yards per day, at an estimated cost $5.25 per cubic yard.

The number of men employed in the headings averaged 45 per day, or 28 miners and 17 muckers or laborers. The work was all done by hand drilling, steam drilling being abandoned after the first day or two. Two shifts of eleven hours each was found to be most economical, as less time was lost in changing, the men at work having an hour's rest at noon and at midnight.

The temporary timbers of the headings were set so as not to interfere with the timbers that were afterwards to be put in, when the full section should be taken out, many of these timbers remaining in the tunnel, as it would have been dangerous to have removed them on account of the loose material in the roof of the tunnel. Both the temporary and the permanent timbers were so placed as just to clear the brick arching, and so successfully was it done that in but one or two instances was it necessary to cut away any of the timber to allow the keying of the arch.

The ventilation of the heading was obtained at the north end by means of a tin tube about the size of an ordinary rain conductor, say 4 or 5 inches diameter, into the lower end of which a jet of steam was passed, causing an upward current of air and indrawing the foul air from the heading, which was replaced by outside air by the circulation thus caused. At the south end a wooden trunk was used, the section of which was 6 in. by 10 in., steam entering in the same way as at the north end. This was not a very satisfactory way of ventilation, but it answered the purpose; as the air, though close to a person coming in from the outside, did not seem to inconvenience the men at work, and as it took but a short time to clear the air sufficiently after a blast to allow the men to go to work again, nothing further was attempted.

At first it was supposed that the only trouble we might expect would be from the roof, and that the sides would be of sufficient uniformity to stand at the slight inclination below the foot of the heading timbers, but before we had gone far, it was found that we would have to timber to the springing line; for that purpose and with a view of perhaps using the tunnel temporarily to take the material for track-laying through to the work beyond, which was rapidly reaching completion, it was determined to use what is known as the American or self-supporting style made like a wooden arch of 12 × 12 stuff in lengths of 4 feet.

This was deemed the best adapted for the kind of material we had to go through, as was demonstrated by what had been met in the approaches and also in the heading, which is composed of layers of soft and hard red shale, with a few ledges of yellowish brown sandstone, all of which showed fissures and cracks with an inclination of about 10° in the direction of the tunnel, and about 4° to 6° across the face. None of the material was of a nature that could be depended upon to keep a vertical position when exposed to the action of the air.

The benches in the tunnel were started November 12th, 1883, at both ends, and were entirely removed by March 7th, or in about 117 working days. The total number of cubic yards moved was 17,011. The daily progress was 7 feet or 145 1/6 cubic yards were moved on the average each day. The daily force was 153 men, including foremen, miners, muckers and nippers. There were besides seven horses, two small locomotives and fifteen dump cars. The average cost of removing this material was $2.50 per cubic yard.

As soon as the full section was advanced sufficiently so as to make it safe to begin with the masonry, which was about the middle of December, 1883, the footings or side walls were begun at each end, the masonry being put in in sections of 25 feet at a time to allow for setting before the arch was started, the masonry being kept about 100 feet in advance of the brickwork.

The arching was put in in sections of 20 feet, it taking about two days to set and pack a section, working day and night.

The stone masonry for the side walls was started December 18th, 1883, at the south end, and on January 4th, 1884, at the north end, and completed March 25th, 1884, or in eighty-two working days. There are 886 cubic yards of masonry in these side walls, giving an average of 10 5/6 cubic yards as a day's work for five masons and ten laborers.

The brick arching was begun on the south end January 4th, 1884, and at the north end January 14th, and completed or pigeon-holed April 12th, making eighty-six working days. The total number of cubic yards of brickwork was 2,696, giving an average of 31.35 cubic yards as a day's work for two foremen, nine bricklayers and forty laborers. Some of the latter were engaged in packing the arch as it progressed with the materials taken from the tunnel, so as to distribute the weight evenly over the haunches of the arch and to leave no vacancies between the timbers, so that as they decayed the pressure should come early as possible, and by degrees upon all parts of the arch. The packing was done at night while the bricklayers were not at work, it taking nearly as much time to pack as it did to lay the brick in the sections. About 3,600 barrels of cement and 1,400,000 bricks were used in arching this tunnel.

The facades were the last thing finished and proportionately the longest in being done, having been begun April 12th, and not finished till May 3d, 1884, not quite 16¼ cubic yards being the average day's work for seven masons and fifteen laborers.

The stone cutting on the façades equaled 475 days work for one man.

Total length of tunnel excavated		800 ft.
The south façade projects	7 ft. 9 in.	
" north "	7 " 0 "	14 ft. 9 in.
Total length at springing line		814 ft. 9 in.
" " between faces of keystone		809 " 9 "
Clear width at springing line		27 " 0 "
" height above top of rail		19 " 10 "
Total excavation in tunnel		22,807 cub yds
" " per lineal foot		28 5/8 "
" masonry		3.891 "

As follows:

In façade	308 cub yds =	20 13/20	cub. yds. per lin. ft.
" side walls	887 " =	1 1/5	" " "
" brick arching	2696 " =	3 7/100	" " "
The cost of the tunnel was			$119,899.50
" " per lineal foot, including façades			147.16
Excavation cost			$97.97 per lin. ft.
Side walls "		9.11	" "
Brick arching "		35.92	" "
The façades added to the total cost of the tunnel.		4.16	" "

*Read February 7th, 1885. Reprinted from Proceedings of the Engineers' Club of Philadelphia, vol. V. No. 1.

Galvanized-Iron Water-Pipes.

In the course of a paper on the above subject by Dr. F. P. Venable, in the *Journal* of the American Chemical Society, he states that it has long been known that zinc dissolves in water, and that soft water, such as rain-water, dissolves it more easily than hard water, Water containing carbonic acid is specially able to dissolve it. The use of galvanized iron for pipes and tanks being so much on the increase, the subject becomes more and more important, and it is desirable to ascertain, as far as possible, to what extent solution of the zinc coating takes place, and how far water contaminated by zinc is injurious to health. The author quotes several investigators as to the latter point, the evidence being to some extent conflicting, but giving a very decided balance on the side of the view that such water is considerably injurious. Investigations made on behalf of the French Government resulted in the prohibition by the Ministry of Marine of the use of galvanized-iron tanks on board men-of-war. Professor Heaton has given an analysis of a spring water, with a further analysis of the same water after it had traveled through half a mile of galvanized-iron pipe. It had taken up 6.41 grains of zinc carbonate per gallon. Dr. Venable gives the results of an observation of his own, where spring water passed through 200 yards of galvanized-iron pipes to a house, and took up 4.29 grains of zinc carbonate per gallon. It therefore seems pretty clear that drinking water should not be allowed to come in contact with zinc.

GUTTERS.—Gutters should have a fall of at least an inch and a half in every 10-feet length, not less than 2-inch drips at every 15 feet, and be as straight as practicable. Cast lead is best for sheets of great thickness, milled lead for thin. The former is the more pure, but more liable to irregularity of substance. All leads for gutters and flats should be laid perfectly loose and free to expand and contract by heat or cold, never soldered and never in greater widths than three feet.—*Prof. Donaldson.*

CONEY ISLAND.

Its Present Sanitary Condition and the Need of Future Sanitary Improvements.

Examination Made and Report Prepared for ENGINEERING NEWS.

BY WM. PAUL GERHARD, CIVIL ENGINEER, CONSULTING ENGINEER FOR SANITARY WORKS, NEW YORK CITY.

II.

There is an old Spanish proverb which says "that to understand a disease is to half cure it." Adhering to this view I have, in the first article, given a somewhat lengthy and detailed account of Coney Island's present sanitary condition. That improvements are very urgently needed appears to be the universal opinion of all who have given the least attention to the subject. That the present unsatisfactory method of sewage and garbage disposal and the existing filth accumulations seriously threaten the health of Coney Island's inhabitants and visitors, would also seem to be a conclusion without doubt. But the question of just how to effect the needed improvements, especially how to sewer the island and what to do with the sewage after removal from the buildings, has not as yet been satisfactorily answered. Before suggesting a remedy, we will briefly review some of the plans proposed.

It has been suggested to rectify, straighten and deepen out the now tortuous, and in many places shallow, channel of Coney Island Creek, to run the crude sewage from the three largest hotels as well as from the numerous buildings at West Brighton directly into the new channel by means of branch sewers, and to trust to the action of the tide in removing all sewage matters. This plan would not only be costly but impracticable, for it is obvious that the oscillating action of the tide would not effect the desired final removal of the matters suspended in the sewage, and of the larger floating matters, which would soon render the new channel filthy and obnoxious. Moreover the rapid pollution of both Gravesend and Sheepshead Bays would be the inevitable result. A modification of this plan proposes to construct parallel to the rectified channel of the creek a large intercepting sewer, emptying into both bays. This would merely prevent the pollution of the creek, but the quick defilement of the waters of the two bays would still remain an objectionable feature of the plan.

Another plan involves the construction of a main intercepting sewer running the whole length of the island, and discharging all the sewage at Norton's Point, at outgoing tide only. The principal objection to this plan is the great cost of such a sewer; but, leaving the question of economy out for a moment, it appears evident that owing to the extreme flatness of the island it would be very difficult, if not impossible, to secure to the intercepting sewer a grade which would render it self-cleansing. Doubtless it might be possible to resort to artificial flushing but the cost of maintenance would, in this case, be increased thereby very much. Other strong objections against the plan proposed are the great cost of digging deep trenches, such as would be required in quicksand, and the difficulty of keeping out water during construction. A further objection would be the fact that such a large intercepting sewer would, of necessity, be tide-locked to a great distance from its mouth.

Another plan is to carry the whole sewage into tanks or reservoirs, which will be emptied either directly into the sea, at the beach, by carrying an iron pipe of sufficient size about one thousand feet out into the sea, or else by pumping the material into large scow-boats, built for the purpose, which would serve to convey the matter far out to sea, where it could be dumped. The first suggestion is, obviously out, of the question, as by it bathing on the beach would soon be rendered, if not impossible, at least very disagreeable, undesirable and unhealthy, unless the existing lateral currents are strong enough to carry all sewage matters beyond the island, a question which can only definitely be determined by float experiments. The latter plan is costly, and requires the storage of sewage at the buildings for a longer period of time than is desirable to avoid putrefaction. This plan, too, might become objectionable, for much of the solid matters and floating bodies, would doubtless be drifted back, in case of southerly winds, to the beach. Such are the principal plans of sewering the island, of which I have knowledge and which have been set forth from time to time.

None of the methods of dry removal would appear to offer a practicable solution of the problem. For, even if faecal matters could be successfully and economically removed by such methods, the vast amount of slopwater which must be carefully excluded from dry closets, would remain to be dealt with, and would still require the construction of a system of sewers, and a proper disposal, free from annoyance or offense, of the contents of the sewers. This disposal, as is well known, would not materially differ whether excreta were admitted or excluded from sewers, hence such a separation would only increase the cost to the community.

Sewerage of Coney Island.

The chief result to be accomplished is to remove from the buildings, before decomposition sets in, and as thoroughly as possibly, all liquid and semi-liquid matters, capable of being transported by water. The *removal* of the sewage constitutes the first part of the problem. The second, an equally important question, refers to the *disposal* of the sewage. To some extent, as we will see, the manner of disposal will influence the manner of removal.

1. *Removal of Sewage.*

Having decided that a system of sewers for slop-water and excrements is required, the next question is whether any storm-water should be admitted to the sewers, in other words, whether the combined or the separate system shall be adopted. To solve this problem, it is necessary to consider the following facts:

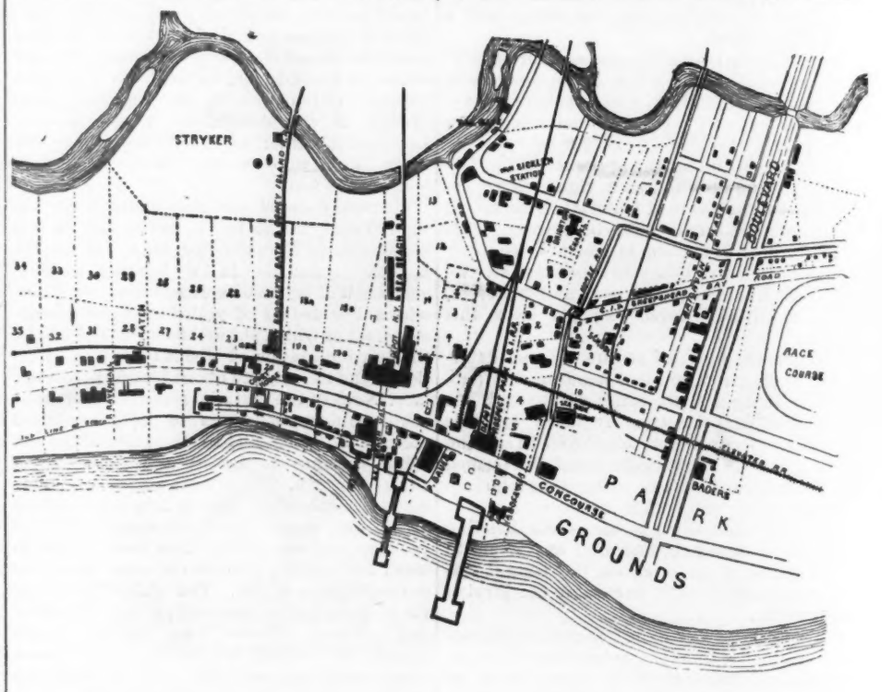
1: That to remove the sewage successfully, it will be necessary to resort to pumping.

2. That it will be impracticable to discharge the crude sewage into the sea, or in other words, that it will be necessary to adopt some system of sewage purification.*

It is obvious that the cost for both pumping and purification will be very much increased by adding to the sewage the whole or even only a part of the rainwater falling upon roofs, yards and streets. Moreover, it should be borne in mind, that the peculiar features of a summer seaside resort such as Coney Island, which is almost deserted during at least six months of the year, render it entirely unnecessary to provide large and costly underground channels for the removal of storm water. The latter may, in this case, be removed with perfect safety, on the surface of properly graded streets, or may be allowed to soak away in the soil, wherever streets are not yet improved. The system of sewerage should consequently be the *separate* system, excluding altogether from the sewers all surface, roof water and subsoil water, and the sewers should take care of fouled household wastes only.

The next question to be decided is the extent of the sewerage system. Shall it cover the whole island, or only a part of it, and which district is in immediate need of sewers? The sewer bill, passed by the Legislature and signed by the Governor, an abstract of which was given in the first part of this report, applies to West Brighton only, the property of railroad companies and of the Manhattan Beach Improvement Company not being included. We think that a system of sewers should be provided for West Brighton, commencing at the West in a line with the Brooklyn, Bath and Coney Island Railroad, but possibly taking in a few of the buildings situated along the main streets west of this line, and extending east so as to include the Brighton Beach Hotel and Bathing Pavilions. The sewage of the few scattered buildings at the extreme western end of the island would require a local treatment, as the construction of a long sewer to reach them would evidently be much too expensive. The buildings of the Manhattan Beach Improvement Company, on the other hand, should, preferably, form a separate system. We hereby avoid a too large extent of the district to be sewered in a lateral direction, which limitation is desirable for economical reasons. The accompanying map, taken, by permission, from Overton's Coney Island Directory, shows approximately the district to be sewered, also the principal streets and buildings. The map is not, however, brought up to date, and there are now more buildings at West Brighton than shown on the map.

The rainfall being entirely excluded, small pipe sewers will answer for the removal of the sewage proper. It will be, however, a rather difficult matter to lay the pipe sewers on a grade sufficient to insure a good velocity of flow in the pipes. If a deep tight well or pit were built somewhere near the Coney Island creek, into which all street sewers would deliver, and from which the sewage would be removed by pumping, the difficulty would still remain of digging deep trenches and laying the pipes in them. The deep excavations in quick sand as well as the construction of the receiving well would increase the cost of sewers very largely and would offer many difficulties from an engineering point of view. Hence the ordinary separate system is not well adapted to the locality. The Shone system of pumping sewage by means of compressed air would be somewhat more adapted, but the very large number of ejectors required would render it very costly.



The case of Coney Island clearly illustrates the truth that no one system is applicable to all localities and conditions. In my judgment, a pneumatic or vacuum system of sewage, would, in this particular instance, offer great advantages from a sanitary, engineering, as well as economical point of view. I do not, however, refer to the Lieurnur pneumatic system, which, although very ingenious, is rather complicated and costly, and has some objectionable features, such as the restriction of the quantity of water to be used in flushing water-closets. It would also require the separation of the excreta from slop-water, the former only being carried away in the pneumatic tubes.

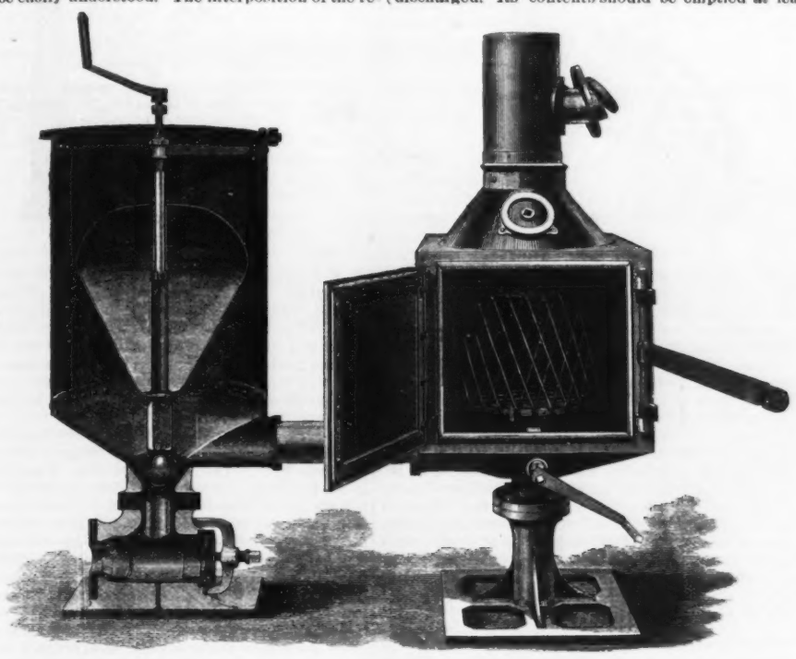
The system of pneumatic drainage, which is particularly applicable to Coney Island, is a modification and at the same time a simplification of the Berlier pneumatic system. This system has been introduced experimentally at Paris, in a district extending from a poor suburb Levallois-Perret to the Madeleine. So far as I am informed, the system is in successful operation, and has given entire satisfaction. M. Berlier, a civil engineer of Lyons, France, first described his system in a pamphlet, published in 1878. The principle upon which his system is based has, however, been foreshadowed, as early as 1861, by M. Belgrand, Chief Engineer, in the following words:

"I had thought of a combination which would radically suppress all the cesspools, and would lead the house drains to a special 'canalisation' sufficiently large to avoid the risk of clogging. These drain pipes might be placed in the sewers and submitted to the action of machinery, which would either aspire or propel the matter within them till it reached distant reservoirs, and there be deodorized, etc., according to the usual methods."

The Berlier system, as constructed at Paris, covers about 3 miles of main suction pipes, of 6 inches diame-

*This statement is made under the supposition that float experiments will prove that by a direct discharge of sewage into the sea, even at a great distance from the shore, the beach will ultimately be polluted by floating matters drifting back to it. It is very desirable that such float experiments should be undertaken at an early date to settle definitely this important matter.

ter. The street pipes are 4 inches in diameter. In all of these a vacuum of about 150 mm (6 inches) of mercury, is kept up by a vacuum pump, located in the central station, and driven by a stationary steam engine. Fig. 2 shows the particular appliances which in the Berlier system are placed in houses between the street sewer and the house soil pipes. The rectangular iron vessel to which the soil pipe is connected at the top, is called the receiver. Within it is placed an iron wire-work, circular basket, the object of which is to retain all foreign substances and foreign bodies, that may be thrown down the soil pipe. Men employed by the Company visit all houses connected with the system about once a week, and by means of a handle which operates the gearing, a powerful centrifugal motion is imparted to the basket. The receiver is then opened and all foreign matters removed. Soluble substances are soon sufficiently broken up by the shaking of the basket to pass through into the "evacuator." Figs. 3 and 4 show a new and improved construction of the receiver. In this there is a wire bottom placed on supports, and acting as a strainer. Above this there are a number of beaters all placed on a horizontal axis, which may be turned by a handle from outside. Solid substances are thereby beaten and reduced in size, while the wire-strainer retains foreign bodies. Fig. 5 clearly illustrates the construction of the evacuator, and its action will be easily understood. The interposition of the receiver between the evacuator and the soil pipe was at Paris, made necessary, inasmuch as the Berlier system was applied there without changing and remodeling the existing house-drainage work. Soil pipes in Paris are unusually large, often as many as 10 or 12 inches, and seldom less than 8 in., inside diameter. Moreover, they often lead directly to vaults or cesspools under houses, and the water closets have large outlets, sometimes entirely without water seal-traps, or valve-seals. Great carelessness exists in Paris as to the matters thrown into soil pipes, and solid refuse of all description, bottles, brushes, towels, rags, boots, etc., are often gotten rid of by being thrown down these pipes, made of necessity large to avoid obstructions. Hence the receiver was, at Paris, a necessary, although disgusting, adjunct to the system.



THE EVACUATOR. THE RECEIVER.

FIG. 2.—DETAILS OF BERLIER'S SYSTEM AS APPLIED TO HOUSES IN PARIS.

In the modification of the system suggested for Coney Island, it is proposed to do away entirely with the receiver, and to connect the soil pipe or house-drain directly to the evacuator.

Briefly stated, the system proposed for Coney Island would consist in a net-work of cast iron pipes, with leaded and caulked air-tight joints, laid in shallow trenches through the principal streets and alleys, with 4-inch branches to the buildings, and finally joined into a larger main leading to a pumping station. The most suitable location of the latter would depend largely upon the system to be adopted for the subsequent sewage treatment, as will be seen hereafter. The pumping station would contain a steam-engine, an air-pump, a reservoir for receiving the sewage, and a lift-and-force-pump. The air-pump keeps up a *constant* partial vacuum in the street pipes. Each branch sewer would terminate at, or near the building, in an iron receptacle, the outlet of which would be closed by a suitable float-valve. Into these absolutely tight receiving vessels or evacuators, all the house sewage would be delivered. The exact construction of the evacuator and the dimensions most suitable, the shape and material of the outlet valve, etc., would all be matters of detail, which need not be further discussed in giving this general outline of the system. There might, at first sight, be some doubt about the proper working of the rubber outlet-valve of the evacuator, but when it is remembered that the apparatus has worked well in Paris, under much more unfavorable conditions (for there faeces *only* are removed, and are not diluted by the addition of slopwater) there appears to be no good reason to anticipate serious obstructions in the modified system proposed. Possibly some preliminary experimenting may become desirable to ascertain the best construction to be adopted for such a float-valve, but there seems to be no doubt that the results indicated will be accomplished. Experiments at Paris have also clearly proven that a vacuum can be easily maintained in an extensive iron pipe system.

The evacuator, although forming an integral part of the system, should not be looked upon as a tight cesspool in the ordinary sense of the term, for it is simply intended as a receptacle to accumulate the sewage for only a few hours, to a volume sufficient to operate the float-valve. The size of the evacuator should be restricted in proportion to the size of each house, the number of its inhabitants, and the amount of waste water discharged. Its contents should be emptied at least every six hours in the case of large establishments, hotels, restaurants, etc., and at least once every day in the case of small buildings. One evacuator might, in the latter instance, even answer for several houses located in a group close together, the advantage gained thereby being a more frequent operation of the evacuator.

The action of the evacuator is as follows: Ordinarily its outlet, which is situated in the bottom of the tank, [see Fig. 5,] is closed tightly by an india-rubber valve, kept in place by its weight, and by the suction in the pipes. Sewage is delivered at the inlet by means of the house pipes. The receptacle gradually fills, until, when a certain height of the water-level is reached, the buoyancy of the float overcomes the weight of the valve, and the suction in the pipes, and lifts the valve from its seat. The contents of the receptacle are then at once sucked with great force into the iron pneumatic pipes, and speedily carried to the collecting reservoir at the pumping station. As soon as the evacuator is emptied, the valve falls again into its place and closes the outlet. The evacuator should, if possible, be placed in an accessible position, in order to enable workmen to inspect it or clean it, if required.

I am aware that in a place like Coney Island, there is not, unlike in the houses at Paris, much chance of water-closets being improperly used, and obstructions occurring in the house drains. The remedy, however, is simple: the outlet of all water-closets should be restricted to three inches diameter, and the trap of the water-closets should also be of this size. Obstructions, of course, cannot wholly be prevented where water-closets are used by careless people but they will, in this case, occur at the water-closets, and not in the pipes or evacuators: and since the water-closets of all public places and hotels should be under constant care of a janitor, such obstructions could easily be removed. As to the other plumbing fixtures, sinks, tubs and basins, they should all be provided with strong, well-fastened outlet strainers. Kitchen sinks in large boarding-houses and hotels, should moreover have grease traps to retain the fatty waste matters, thus preventing the clogging of the pipes with grease.

To those who are familiar with the chief features of the Lieurnur pneumatic system, it will be at once apparent that the modification of the Berlier system of sewerage, as suggested for Coney Island, is superior to it, first in being much simpler, and above all, entirely *automatic*; second, in effecting a removal of the house sewage, at much smaller intervals: and third in keeping up in all the street pipes a constant vacuum, thus effectively preventing any escape of sewer gas into the soil or into houses.

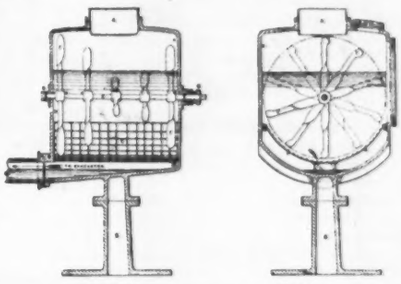


FIG. 3. FIG. 4.

SECTIONS OF IMPROVED FORM OF RECEIVER.

Compared with the ordinary gravity sewers of the separate system, the pneumatic system proposed would offer the following advantages:

1. The pneumatic sewers require no fall, all sewage being transported by atmospheric pressure; hence the pipes may be laid level for long distances, or may even be laid with an up-grade (the limit practically being about 20 feet, which however would not be reached at Coney Island,) and depressions or trapping in pipes, inverted syphons etc, would not interfere with the working of the system.

2. The trenches can be kept quite shallow, all that would be required being to lay the iron pipes sufficiently deep so they would not be affected by frost or injured by passing vehicles.

3. Contamination of the soil is absolutely prevented, as even with joints which have slight leaks, no sewage can escape. The suction in the pipes, moreover, tends to keep the joints tight.

4. Man-holes for ventilation are entirely dispensed with.

5. There being a constant suction in the pipes, no sewer gas could possibly escape into the house soil pipe or into the house through defective traps or fixtures.

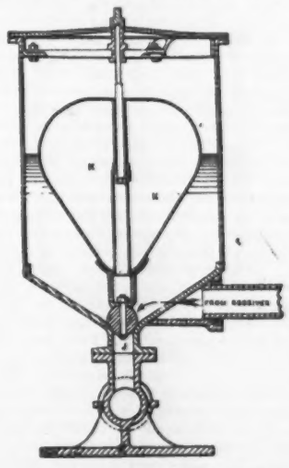


FIG. 5.—SECTION OF EVACUATOR.

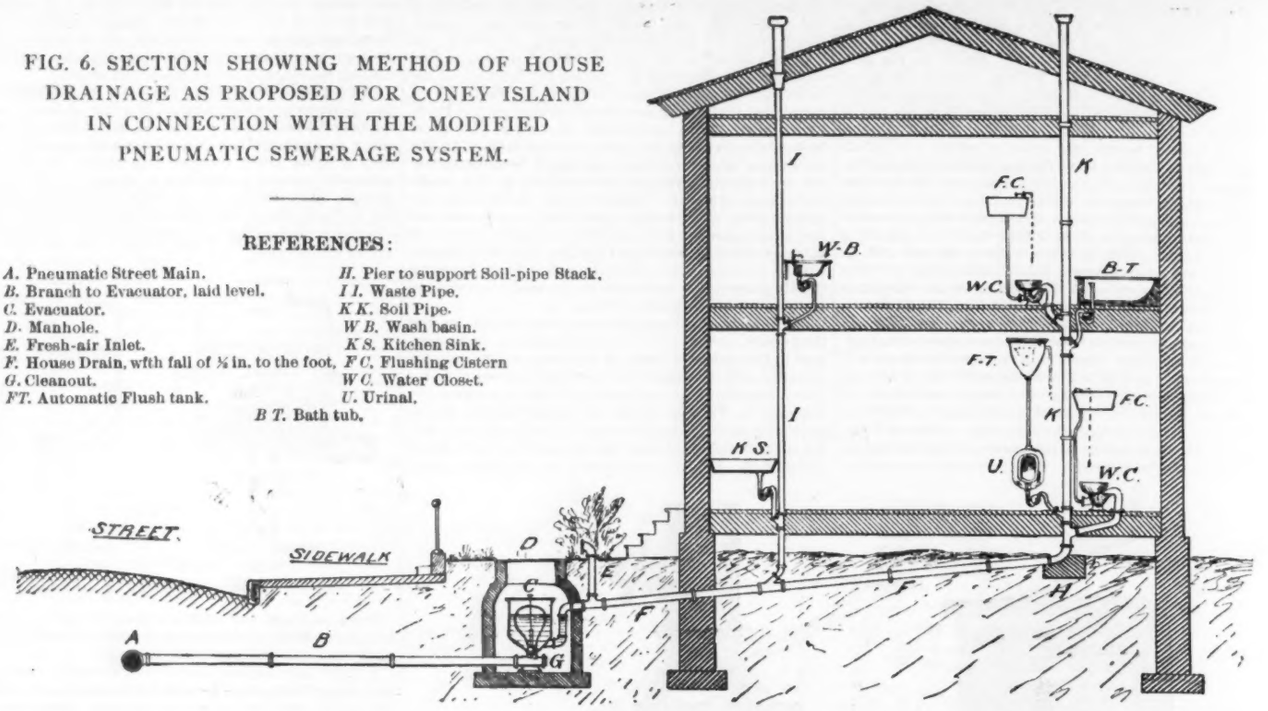
A commission of civil engineers, chemists and physicians appointed in 1880, by the Prefect of the Rhone, to inquire into the working of the system at Lyons, where M. Berlier constructed his first experimental sewerage works, made a full and favorable report, in which it was stated among others that "the possibility of draining and drawing liquid sewerage from one distant point to another by means of iron pipes, in which a vacuum to a certain degree is maintained, can, considering the results obtained by M. Berlier, be now no longer contested. It is even demonstrated that this result can be obtained with great facility and economy."

The Society for the Encouragement of National Industries at Paris, appointed M. Rousselle, Chief Engineer and Inspector General of bridges and roads, to make a report on the new sewerage system. The conclusions reached in this are that "M. Berlier has

FIG. 6. SECTION SHOWING METHOD OF HOUSE DRAINAGE AS PROPOSED FOR CONEY ISLAND IN CONNECTION WITH THE MODIFIED PNEUMATIC SEWERAGE SYSTEM.

REFERENCES:

A. Pneumatic Street Main.
B. Branch to Evacuator, laid level.
C. Evacuator.
D. Manhole.
E. Fresh-air Inlet.
F. House Drain, wfth fall of ½ in. to the foot,
G. Cleanout.
FT. Automatic Flush tank.
H. Pier to support Soil-pipe Stack.
I I. Waste Pipe.
K K. Soil Pipe.
W B. Wash basin.
K S. Kitchen Sink.
F C. Flushing Cistern
W C. Water Closet.
U. Urinal.
B T. Bath tub.



solved the most arduous problem by the most ingenious devices."

The National Society of French Architects also appointed a commission to investigate the merits of the system which reported very favorably and settled that "the public health would be improved by applying the system on a large scale."

It is important that, should this modified pneumatic system be adopted at Coney Island, the drainage of all buildings, and the inside plumbing work, which are at present very defective and unsanitary, be all reconstructed and made to correspond to certain rules and regulations, which the local Board of Health should have power to enforce. Fig. 6, illustrates in sketch the manner of arranging a system of house drainage connected with the modified pneumatic sewerage system. In the case of buildings, having basements or cellars the evacuator should be placed in these; otherwise, it should be placed in a covered man-hole outside of the building, care being taken to protect it against freezing. Each soil pipe and waste pipe should be extended full size at least two feet above the roof. Waste pipes should not be larger than two inches diameter, and the size of soil pipes should be restricted to four inches. The horizontal pipe connecting the soil pipe with the evacuator should also be four inches inside diameter. There should not be a running trap between the house drain and the evacuator, but a fresh air pipe leading to out of-doors should enter the soil pipe at its lowest point above the water level in the evacuator, to establish at all times a circulation in the house pipe system. All fixtures such as wash basins, urinals, bath tubs, kitchen sinks and slop-hoppers should have strong and securely fastened strainers. Kitchen sinks of hotels and eating houses should have grease traps to arrest fatty waste matters. Each fixture to be separately trapped by a seal-retaining anti-siphoning trap, not larger than 1¼ inches in diameter. Water-closets to be improved hopper-closets of earthenware or enamelled iron with flushing cisterns. Outlets of all water-closets to be restricted to three inches diameter, and traps not to be larger than three inches bore. Frequent inspection and cleaning hand-holes to be located on the line of the main house drain.

Suitable public water-closets and urinals should be erected, not only for the comfort and convenience of the visitors to the island, but also for the sake of decency and to prevent nuisances by the pollution of open spaces. There can be no doubt whatever about their great usefulness in much frequented localities such as West Brighton. They should be properly distributed and readily accessible, but at the same time they should be screened as much as possible from public view in order to insure privacy. Entirely separate buildings should be provided for both sexes. The public water-closets should be in charge of reliable janitors who should be in constant attendance, and exercise a close supervision in order to prevent obstructions of the water-closet apparatus. The running expenses incident to the management of such public places might be defrayed by charging a small amount for the use of the conveniences. There can be scarcely any doubt about the appreciation on the part of the visitors to the island of such arrangements. It is not necessary however in this general report, to give details as to the mode of construction of such buildings, and as to the plumbing apparatus best adapted to such use.

We have not included in the district to be sewered, the buildings of the Manhattan Beach Improvement Company. It is believed that it would be less expensive to apply to them a separate treatment than to connect them by a long suction pipe to the pneumatic system suggested for West Brighton. In the first part of this report we have already indicated how the present system at the Manhattan Beach and Oriental Hotels may be improved. A separate pneumatic system, in all respects similar to the one described, would answer equally well, and at the same time, overcome the objection to a gravity sewer from the Hotel to the extreme eastern point of the island. The introduction of a pneumatic system would, of course, involve the reconstruction of the drainage of the buildings, but, as this appears to be imperfect at present, a change in this respect would only offer additional advantages.

2. *Disposal of Sewage*

Having explained how the sewage of Coney Island can be removed from the buildings in a rapid and thorough, yet economical manner, the next question requiring consideration is what to do with the sewage accumulating in the collecting reservoir at the pumping station. Unless float experiments demonstrate conclusively that the existing lateral current in front of the beach is sufficiently strong and of such a direction as to prevent the ultimate return to the beach of any sewage or floating bodies discharged at a considerable distance from the shore into the sea, this method of getting rid of the sewage should evidently not be adopted. It would, also, obviously be wrong to deliver the crude sewage into Coney Island Creek, without any attempt at purification by removing the suspended as well as part of the dissolved organic impurities.

Assuming that a purification is necessary, the first thing to be done is to remove the foreign solid and coarse floating matters, which is readily accomplished by suitable mechanical separation by means of straining arrangements. This should be done before the sewage is lifted from the collecting reservoir. The strained sewage contains much dissolved matter as well as finer flocculent or suspended particles which, while fresh, form fertilizing substances of some value to the farmer. Hence the idea at once suggests itself of utilizing the sewage on the land. While we do not entertain any hopes that the disposal of the sewage by irrigation over, or by filtration through, land will prove in the end very remunerative, yet we are convinced that it would not be difficult to obtain in the town of Gravesend sufficient grounds on the mainland between the ridge and the creek where broad sewage irrigation, or else intermittent downward filtration might be practised, in such a manner as to at least pay expenses. The disposal of sewage by irrigation over, or by filtration through, land is based upon the purifying qualities of the upper strata of the soil, assisted by the absorption of the nutritive elements of sewage by vegetation. To be managed successfully it requires that the sewage be delivered in the irrigation field in a fresh condition. It also demands a thorough underdrainage of the irrigation field. The land should always be subdivided, and use made at the time of only one section, while the others are being purified by oxidation. Thus it will be possible to avoid the saturation of the soil with sewage and moisture. If this plan of sewage purification is adopted at Coney Island the pumping-station should be located near the Coney Island creek, and from it the sewage should be delivered in a pressure conduit to the irrigation farm. If the price of the land would prevent the purchase of a sufficiently large area to practice broad irrigation, it may be advisable to purify the sewage first by chemical treatment, and subsequent filtration through the soil. Since it costs more or less to adapt a tract of land to sewage farming, it may be advisable to reduce the area required, by removing first some of the impurities of sewage by a system of precipitation. This is a question which can be decided only by detailed estimates. It should be remembered, however, that Coney Island seems to offer special facilities for irrigation, as the amount of sewage is large only during the summer months, at a time when the desired purification by land is much assisted by vegetation, while during the winter season the amount is so small as to give the land ample time for self-purification.

If for any reasons which it is impossible to foresee, it should be difficult to obtain farm lands for sewage irrigation, the sewage should, after straining, be clarified and purified by chemical precipitation, in large and suitably constructed settling tanks. While it is not, at present, feasible, by any of the known chemical processes, to restore sewage to the purity of ordinary water it is at least possible to reduce the amount of impurities in solution to such an extent as to render the resulting effluent fit to be admitted into a watercourse. In the particular case of Coney Island all that can reasonably be demanded is that the effluent may be delivered into Coney Island Creek or into the sea without in either case creating a nuisance dangerous to health, or even causing offense to sight or smell. Without entering into a detailed consideration of the many processes of chemical precipitation, the choice would seem to be restricted to the lime process, the A-B-C process, the sulphate of alumina and lime process, and the process using perchloride of iron as a precipitant. It is not necessary to enter at present into a consideration of the construction of the settling tanks, the mixing apparatus, and the various details required for the successful operation of a chemical precipitation process. The processes named, none of which have been put to a practical test on a large scale in this country, have all given more or less good results in England. All of these processes arrest, to a certain extent, decomposition, and cause the products to be comparatively inodorous and inoffensive. Preference should, obviously, be given to a process which effects a rapid, and at the same time, maximum amount of precipitation of sewage impurities with the minimum amount of resulting sludge, for the disposition to be made of the latter presents some difficulty. The lime process is in this respect said to be inferior to the other processes named, besides giving an effluent, which is injurious to fish. The resultant sewage sludge, usually consisting of ninety per cent of water must be dried artificially and

thus be reduced in volume in order to be in a removable and transportable shape. It does not constitute a manure of high value, yet it is believed that farmers could make use of it, and would gladly take it at the actual cost of manufacture. Attempts have at various times been made to manufacture the sewage sludge into cement, or bricks, by the addition of suitable ingredients. The best method of treating sewage sludge at present known, appears to be to reduce it in volume in large filter presses, the resulting product being a circular cake which can be readily handled. But, whatever the process of manufacture be, care should be taken to prevent its creating a nuisance.

It should be borne in mind that the laws of health should be primarily considered, and that the aim should be not so much the creation of a marketable article, as the purification of sewage and the rendering it innocuous. If this can be done in a manner so as to cover actual running expenses, including the interest on first cost of purification apparatus, all that is necessary and desirable would seem to be accomplished. In the present state of the sewage question it is not considered feasible to manufacture from town sewage an artificial manure which will realize large and handsome profits.

If chemical purification only is adapted, without subsequent further purification of the effluent by irrigation or land filtration, the pumping station may be located either near the Coney Island creek, at the rear of the district to be sewered, or else at the western extremity of the island, if discharge into sea when the ebb tide sets in, is preferred. This plan would, of course, require the laying of a much longer suction main and may prove objectionable on that account.

Should it be considered inadvisable to discharge the effluent into the sea after purification by straining and chemical precipitation, it may be further treated by filtration through a large Farquhar-Oldham sewage filter, the chief characteristic of which consists in the revolving cutter which removes the surface of the filtering material, usually sawdust, as soon as it becomes clogged, thus practically establishing, at intervals as often as may be desired, a new filter. This additional mechanical filtration would, without doubt render the sewage sufficiently pure to allow of its being discharged into Coney Island Creek.

Garbage Disposal at Coney Island.

The prompt and thorough removal and disposal of garbage from human habitations is only second in importance to a proper system of sewerage, and the efficiency with which the collection and removal is accomplished has, without doubt a very great influence upon the health and comfort of a community. The laws of hygiene require that offal and house refuse which are continually produced wherever human life exists should be removed from habitations and their immediate surroundings, and from streets, alleys and public squares of a village or town, before decomposition sets in. The contents of dust and swill barrels are always subject to rapid decomposition and soon become highly offensive, and this is particularly the case during hot weather; hence in summer time a daily removal is especially important.

As appears from the investigation made there is at present at Coney Island no system of scavengering whatever, and the existing slovenliness in the removal of offal and refuse cannot be too severely condemned. As the problem does not present difficulties as serious as the sewage question it is somewhat a matter of surprise that proper steps should not have been taken long ago with regard to the daily removal of house refuse and the equally necessary daily street cleaning. This duty should devolve upon the Board of Health which should be invested with sufficient power and authority to contrive and make suitable arrangements for the purpose. The cost arising to the community from a process of garbage disposal should be regarded, not unlike the cost of a system of sewage disposal, a necessary expenditure in the interest of the public health. Both processes, sewerage as well as scavenging, are needed, and are essential to the maintenance of cleanliness. In considering the best and most economical method of collecting, transporting, treating, utilizing or disposing of the refuse material, the subject may well be considered under the two headings of removal and disposal.

1. *Removal of Garbage.*

House refuse is made up of three kinds of waste materials, namely first, animal and vegetable matters, second, mineral matters and finally miscellaneous larger rubbish. Kitchen offal or swill is largely made up of food remnants from the table, and animal and vegetable waste matters derived from preparing food. It includes meat and fish bones, waste bits of birds, meat offal, kitchen grease, potato parings, cabbage leaves, fruit peelings, onions, turnips, apples, etc. While in the case of smaller houses much of this kitchen refuse may be burnt up in the kitchen range, it is imperative that it should be removed daily with the greatest regularity from all restaurants, taverns, hotels, boarding houses on the island, as it is more or less wet, and decomposes very rapidly. The removal should be effected promptly and quickly in well-covered, water-tight wagons, and it may be accomplished either by contracting with responsible and trustworthy scavengers, or else it may be carried out directly under the charge of the village authorities. The latter system, whereby the authorities own suitable scavenging apparatus and the necessary wagons and horses and employ drivers and scavengers, has much to recommend it. The garbage removal should be effected during the early morning hours. The proprietors of all hotels, restaurants, boarding houses, as well as owners or tenants of private houses should be required to place, at or before the time fixed for removal, the refuse accumulated during the previous day in the swill-barrel, at or near the street curb. The receptacles in which refuse is kept should be of iron, preferably circular in shape, and of a strong and easily portable construction. The iron should be galvanized or otherwise efficiently protected against corrosion. The vessels should have suitable handles as well as tight-closing lids or covers, so as to prevent their offensive contents from being exposed to the sun and emitting noxious odors and to the eyes of the passers-by also to prevent their contents from being scattered about in the streets either by the force of the wind, or else by being accidentally or purposely upset. The covering up of the swill barrel is also important in order to prevent the contents from being wetted during a rainstorm or from moisture in the atmosphere. Immediately after being emptied, the swill receptacles should be removed from the streets. For the larger hotels it may be desirable to provide a double set of receptacles, one to be taken and placed on the wagons, removed and returned the next morning. This would avoid altogether the objectionable disturbance of the contents of the barrel by emptying into the garbage wagon in front of buildings. The detailed construction of garbage-carts is a matter which it is hardly necessary to enlarge upon in this report. Suffice it to say that the carts should be absolutely water tight, and impervious, to prevent the possibility of filth absorption. The covers of the carts should fit tightly so as to avoid the spread of objectionable odors while the wagons are passing through the streets. The village authorities should see to it that the garbage carts are frequently and thoroughly scrubbed, washed and cleaned, and kept in good repair.

The mineral refuse consists of coal and wood ashes, of house dirt, yard sweepings, small rubbish and miscellaneous dry refuse matters. These should not be allowed to be mixed with any organic house and food refuse whatever. In fact, the aim should be to keep the ashes as free as possible from admixture with filth of any kind. Then, and only then, they may be used with advantage to fill in low spots, building lots or for grading of streets and sidewalks. If ashes, as is usually the case, are mixed with refuse, street sweepings, foul liquids, etc., the disgusting practice of dumping the obnoxious mixture upon building sites should not be permitted, as it is well-known that it is extremely unhealthy to erect habitations upon such sites. Practically, it is next to impossible to prevent the admixture with the ashes of the coarser miscellaneous house rubbish, such as house dirt, sweepings of house and yard, mud, broken bottles, oyster cans, tin cans, worn-out kitchen utensils, preserve jars, medicine bottles, broken toys, old mattresses, straw, hay, old boots, hats, baskets, pieces of matting, oil cloth, carpet, wall-paper, leather, rubber, paper, pieces of cloth bits of wearing apparel, hoop-skirts, towels, napkins, shirts, sheets, stockings, rags, stones, clinkers, brick-bats, plaster, flower pots, broken glass, old crockery, old iron, scrap tin, bones, hair, sticks, shavings, oyster and clam shells, small dead animals, such as mice and rats, or dogs, and even small portions of excrements from domestic animals, etc. This miscellaneous rubbish should be removed in special separate carts, covered with canvas or tightly fitting lids provided by the village authorities. The form and construction of the scavenger carts are matters of detail into which it is not necessary to enter now. Householders and property owners, hotel and boarding house keepers, etc., should provide special portable metallic ashbarrels, fitted with well-closing lids to prevent the scattering about of ashes and dirt and the admixture of rainwater. Where large quantities of litter accumulate, householders should provide several vessels, the weight of each being restricted so as to facilitate the work of the scavengers in lifting and emptying the vessels.

At Coney Island the removal both of garbage and of ashes should be accomplished daily during the summer season in a systematic manner at as near the same hour as possible, so that the boarding houses and hotels may know when to put the barrels out. Both receptacles, for ashes and for swill, should be kept most scrupulously clean, so that they may not become a nuisance during exposure in the street.

Should the purchasing and maintenance of a double plant of scavengers' carts, and the employment of a double gang of scavengers recommended above be considered too expensive, a single cart of a special construction, having two compartments separated by a movable partition, may be used, but this system of removal cannot be recommended, as it might lead, unless closely watched and superintended, to a careless mixture of all house refuse.

2. *Disposal of Kitchen Garbage and House Refuse.*

The best use to be made of ashes has already been alluded to, and to accomplish it, it will be necessary to provide outside of the village, a dumping ground, upon which ashes and house-rubbish may be thrown, to be screened and sifted, picked and sorted. Many of the hard refuse substances, such as old iron, tin, glass, bottles, lead, etc., may be sold to junk dealers, or otherwise given away to those who are willing to remove them promptly. Paper, baskets, straw, matting, shavings, etc., may be burnt up.

The disposal of the large quantities of offal and foul refuse from hotels and boarding-houses, is a more difficult problem. It is believed, however, that a large part of the swill can be disposed of with advantage, to market gardeners and farmers, on the main land, who may convert the matter into compost, or use the swill to feed swine. Whatever cannot be gotten rid of in this manner, should either be carted to remote places, and dug well under the surface of the soil on the mainland, or else it should be burnt and destroyed by subjecting it to the all-purifying action of fire, in some sort of a garbage-cremator. It is possible that in a place such as Coney Island, where hotels and eating houses predominate, the immense quantities of offal to be dealt with will make the latter plan necessary. Space forbids to discuss in detail the arrangements for such a garbage-cremator. It is important, however, that whatever the construction of the crematory furnace may be, the gases should be made to pass under the grate of the furnace, so as to be purified before passing out at the chimney, in order to prevent a defilement of the atmosphere in the neighborhood of the garbage-cremator.

If the construction of the latter is not looked upon with favor, the only alternative plan would be to build a dock, hire tow-boats, dump the refuse material upon large scows or barges, and carry it to sea to a sufficient distance out into the deep water, so as to make sure against the sunken material being washed back to the shore.

Street Cleaning.

It will be readily admitted that one may fairly judge of the character and prosperity of a place, from the thoroughness with which its streets are cleaned. A wet, muddy street surface is very disagreeable for pedestrians crossing it, and the mud itself is also very injurious to clothing. Ill-drained streets, full of pools of stagnant water, and spattered with horse dung, must necessarily injuriously affect the health of the people. Dusty streets, on the other hand, are equally undesirable and injurious to the lungs of street passers, and to persons living in the houses.

At Coney Island, the principal streets and drives are kept in a far from satisfactory condition. The comfort and health of the transient visitors, as well as of the guests, in boarding-houses and hotels, demands that a better system of street-cleaning than at present exists, should be carried out. The sweeping of the streets should be done daily in the early morning hours, and the street-sweepings, consisting of the worn materials of the roads, of mud, horse-dung, leather, scrapings, some house and yard sweepings, and even offal should not be allowed to accumulate, and ought to be removed in carts. It should not be used for filling up building sites. In dry weather, the sweeping should always be preceded by sprinkling, in order to arrest dust. The cleaning of gutters should also be looked after.

Sanitary Ordinances.

In order to guide property-owners, and house-holders in the carrying out of an efficient system of sanitation, and also to assist the village health authorities in the enforcement of sanitary measures, tending to promote cleanliness and health, and aiming at abolishing any and all forms of filth, a code of sanitary ordinances should at once be prepared, adopted, and enacted. These ordinances should have reference to sound and healthful building construction, in particular to subsoil drainage, and prevention of dampness in walls. The manner of making connection between any building and the pneumatic sewers should be regulated by law. The whole system of plumbing in buildings should be made to conform to a code of plumbing regulations tending to a simplification and improvement of the character of such work, and the work itself made subject to inspection by the Board of Health. Regulations should also be enacted, abolishing entirely any privy-vaults or cesspools in streets provided with sewers, and the connection of houses to the latter should be made compulsory. Rules should also be passed regarding the manner of collection and removal of garbage, offal, etc., and the construction and management of earth or ash-closets along streets not included in the district sewered.

We have not entered upon a consideration of the probable cost of the sanitary improvements suggested. To arrive at even an approximate idea of the expense of a sewerage system would require a much more detailed survey of the district, streets and buildings to be sewered, as well as a close investigation into the cost of sewage purification works. Particularly as regards the latter it should be borne in mind that in this

country, if we except the single instance of sewage irrigation at Pullmann, Ill., we have no available data, derived from actual experience, to guide us in making estimates, and as regards the proposed alternative method of purification by chemical precipitation, and mechanical filtration we have to look to actual trials and experiments on a large scale, made in England and on the continent of Europe.

The main object of this investigation is to emphasize the *absolute need of carrying out sanitary improvements at Coney Island without further delay.* As soon as the construction of suitable works is decided upon, it will not be a difficult matter to arrive at the expenditure of funds which the construction of sanitary works will require. But it may, perhaps, be well to add a few words of caution as to the manner in which the authorities should proceed. Let it be understood that, at Coney Island as much as anywhere else, the first steps to be taken should be to make the preliminary plans and surveys, and to work out in detail a plan of sewerage and sewage disposal based upon the data obtained. At an early date careful float experiments should be undertaken to ascertain definitely if a discharge of a part or the whole of the sewage directly into the sea is at all feasible. That it will be advisable to engage engineering talent to prepare the plans and to discuss the difficult problems which present themselves, it would be a matter of supererogation to assert. The employment of an expert who has made this branch of engineering a special study and has gained practical experience in sanitary works will result in the ultimate saving to the community of many useless expenditures, or palpable errors in either the plan or the construction of the works. No greater mistake could be committed than to ask at once for competitive bids from contractors for a system of sewerage at Coney Island, and to award the work to the lowest bidder, for the bids may be based on widely differing plans, and hence would not allow of a common comparison.

As is usual in almost all communities, there will be, without doubt, tax-payers who will be sceptical as to the beneficial results due to a system of sanitation. Such should bear in mind, in the first place, that it is tolerably certain that unless improvements are soon carried out, the prosperity of Coney Island as a summer resort will suffer a serious decline. It will be also well to consider the facts proven by statistics, that after the adoption of measures preventing the contamination of the soil and of the atmosphere, the mortality from typhoid fever alone was reduced in twenty-one English cities from 30 to 75 per cent, and that according to Pettenkofer, a similar reduction was effected at Munich, Germany, where the mortality from typhoid fever was reduced from 2.42 to 1.66 per thousand. At Frankfort-on-Main the death-rate from the same disease was reduced from 0.86 to 0.21 per thousand, by the introduction of a sewerage system. According to Dr. Buchanan the general death-rate of twenty-four English cities was reduced from 24.7 to 21.9 per thousand by the construction of sanitary works, such as sewerage, public water supply and the enactment of a system of garbage disposal. In Dantzic, Prussia, a similar result due to the same cause was effected, the general death-rate being reduced from 36.85 to 28.54 per thousand. Many more similar facts might be given, but we will content ourselves with quoting the following interesting table which we take from a recent issue of the *Sanitary News*, giving the death-rate from typhoid fever, a disease which is known as being especially fatal where unsanitary surroundings exist:

City.	Period.	Sanitary condition.	Death-rate per 100,000 from typhoid fever.
Frankfort-on-Main	1854-59	No sewage.	87
	1875-80	Sewerage completed.	24
Dantzic	1865-69	No sewerage; no proper water-supply.	108
	1871-75	Water-supply introduced.	90
	1876-80	Sewage added.	18
Munich	1854-59	No regulati[illegible]or keeping soil clean.	24.2
	1860-65	Reform begun by cementing sides and bottoms of cesspools.	16.8
	1865-73	Partial sewerage.	13.3

To sum up, a system of practical sanitation at Coney Island would embrace:

1. The construction of a pneumatic system of sewerage for household wastes only, including the contents of water-closets, and the collection thereby, of all the sewage at a central pumping-station.

2. The purification of the sewage of the district sewered—unless the discharge into the sea is practicable—by irrigation upon land only, or by chemical precipitation combined with filtration through soil, or by chemical precipitation only, or, finally, by chemical purification followed by mechanical filtration with ultimate discharge of the effluent into Coney Island creek.

3. The provision, in suitable locations, of separate public water-closets and urinals for both sexes.

4. The arrangement and enforcement of a complete system of garbage removal.

5. The adoption of a proper disposal of the house refuse, either by removal to farms on the mainland, or by burning it in garbage cremators, or by carrying it away in boats, and dumping it into the sea at a sufficient distance from the shore to insure against the defilement of the beach.

6. The carrying out of an efficient system of cleaning and watering streets.

7. The drainage and filling up of lowlands and swamps.

8. The abolishment of privies and vaults and leaching cesspools, and the erection of suitable earth or ash-closets for all buildings not in reach of sewers.

9. The enactment of legislation prohibiting the pollution of the soil and of the air, by passing a series of sanitary ordinances, the enforcement of which should be made the special duty of the Board of Health.

The Liverpool Water Works.

The Water Engineer, Mr. George F. Deacon, has prepared the following report, in accordance with the instructions of the Water Committee of the Liverpool Corporation, with regard to the progress of the Vyrnwy works up to June 30th last:—

The embankment now being constructed across the valley of the Vyrnwy will impound the upper waters of the river, and will form a lake, having an area of 1,115 acres, at an elevation of 825 feet above the mean sea level. The length of the embankment from rock to rock will be about 1,255 feet; its height above the original river bed to the ordinary top water level, about 84 feet, and to the parapet of the roadway to be carried on arches along the embankment, about 98 feet. The embankment is being formed of rubble masonry, set in Portland cement mortar, founded upon sound rock of the Carodoc beds in the lower Silurian formation. This rock extends across the valley and up both sides thereof. The greatest depth of its surface below the river bed, within the area to be built upon, is 60 feet, so that the total height of the masonry above the lowest part of its rock foundation will be about 158 feet. Before the works were commenced the rock in that part of the valley across which the masonry embankment was being constructed was covered with glacial drift, containing boulders of several tons weight, and blocks of rock of 40 or 50 tons dislodged by glacial action. Above this drift lay an alluvial deposit, the result of silting up by the rock *débris* and *detritus* brought down by the many streams which feed the present river. In times of heavy rain this river flooded the whole width of the valley, and it was therefore desirable, before commencing the present excavations, to divert it from the left bank of the valley, where the rock is at a considerable depth below the surface, to the right bank, where it is close to the surface, and to make the new channel of sufficient capacity to pass the highest floods. This work had been completed when the memorial-stone was laid on July 14, 1881. The excavation to the rock then proceeded rapidly, and on October 25, 1882, the masonry was commenced on the deepest part of the rock. About 126,765 cubic yards have since been built. The stone used is much of the same nature as that forming the foundation, and is being quarried in the Cynon Valley, at a point about a mile and a quarter distant from the site of the embankment. It is brought to the embankment upon a tramway worked by locomotives. The formation of the statutory roads which will skirt the lake is progressing satisfactorily. About 7.45 miles have been completed. The bridges to carry the roads over the Cainant Pistyll, the Afon Hirddydd, and the Eunant are completed, and that over the Rhiwargor river is nearly finished.

The aqueduct from the intended Lake Vyrnwy to the present Prescot reservoirs of the corporation is 67½ miles in length. It consists of three tunnels, through each of which the whole expected yield of the works may be passed without pipes, and of three lines of parallel pipes, only one of which, with a few short exceptions, is being constructed at present. The discharging power of each line of pipes will exceed 13,000,000 gallons per day. The Hirnant tunnel, 2 miles 390 yards in length, is being constructed from the intended lake to the Hirnant Valley. It will form the first part of the aqueduct. The inlet end was driven and timbered by corporation men through earth and loose rock to moderately sound rock for a length of 128½ lineal yards. The outlet end was similarly driven and timbered for a length of 267 yards, and was lined with concrete and brickwork. For the driving and, where necessary, the lining of the intermediate portion, 3,514½ yards in length, a contract is being carried out by Messrs. J. W. & M. H. Larmuth, of Manchester. This work is being done by blasting, and the shot holes are drilled with machines worked by compressed air. The total length of the tunnel now driven, but not completed, is 3,604 2.3 yards. From the outlet end of the Hirnant Tunnel to the inlet end of the Cynynion Tunnel, the length of pipe line is 13 miles, 460 yards. This portion of the aqueduct has, with the exception of certain special works, been completed. The length of the Cynynion Tuunel is 1,482 yards. For driving—and, where necessary, the lining also—a contract has been entered into with Messrs. Gabbutt & Owen, contractors, of Liverpool, who have now driven, but not completed, the whole length. Between the outlet of the Cynynion tunnel and the inlet of the Llanforda tunnel, a distance of 165 yards, lies the Morda Valley, which will be crossed by inverted syphon pipes, carried over the river by a small masonry aqueduct. The length of the Llanforda tunnel is 1,607 yards, of which the whole has now been driven, but not completed. The work is being done under the same contract as the Cynynion tunnel. The site for the balancing reservoir at Oswestry, and for filter beds is near the outlet of the Llanforda tunnel. From the Oswestry filter beds to Malpas the distance is about 17½ miles. Contracts for the supply and delivery of the pipes have been entered into with Messrs. Cochrane & Co., of Dudley, and contracts for the pipe-laying have been entered into with Messrs. Fotherby & Son, of Burnley, and Messrs. Jowett & Dyson, of Brighouse. About 16¾ miles of this part of the pipe line have been laid. From the Malpas tank to the Cotebrook tank, a distance of about 11 miles 1,033 yards, the construction will be generally similar to that of the last length.

A contract for supplying and delivering the pipes has been entered into with the Widnes Foundry Company, and another for laying them with Messrs. Fotherby & Son. About 5¾ miles of this part of the pipe-line have been laid. From the Cotebrook tank to the Norton water-tower, a length of about ten miles, 1,720 yards, the construction, except beneath the river Weaver, will be generally similar to that of the last two lengths. A contract for the supply and delivery of the ordinary pipes has been entered into with the Widnes Foundry Company, and another for the pipe-laying with Mr. Joseph Walker, Crewe. About 10½ miles of this pipe-line have been laid. From the Norton water-tower to the existing Prescot reservoirs, a length of about nine miles 475 yards, the construction, except beneath the river Mersey, will be generally similar to that of the last three lengths. A contract for the supply of the ordinary pipes has been entered into with Messrs. D. Y. Stew-

art & Co., of Glasgow, and another for the pipe-laying with Mr. John Jowett, of Brighouse. About eight miles of pipe-line have been laid. Contracts for the following materials and work have been entered into:—High-pressure screw-cocks, etc., for the pipe-line, the Glenfield Company, Limited, Kilmarnock; two valve-houses at Cuerdler and Rainhill, Mr. Thomas Tyson, Liverpool; 12 and 18-inch pipes for the pipe line, Messrs. Cochrane & Co.; and 12-inch pipes for the pipe-line, Messrs. D. Y. Stewart & Co.

To the report is appended a statement of the cost of the principal works executed prior to June 30. The works in connection with the masonry embankment, statutory road diversions, tunnels, and pipe-line have so far involved an expenditure of 899,794*l*. The expenditure incurred with respect to plant, machinery, horses, and construction of temporary buildings for works and offices has been 100,239*l*. The sales and rents have reached 9,595*l*., leaving a balance of 90,644*l*., the selling value being estimated at 49,844*l*. The other items are: Preliminary works, inauguration ceremony, council and committee expenses, 4,410*l*.; corporation estate and farm, 3,946*l*.; engineering expenses, 13,298*l*., and land and easements, 238,463*l*. The total amount expended to June 30, was therefore 1,250,555*l*. The total cost to the same date, after allowing for the selling value of plant at that time, was 1,200,701*l*.—*London Architect.*

Safety of Railway Travel.

An opinion has more than once been publicly recorded that it is less dangerous to traverse an African jungle than it is to walk about the streets of London. Be this as it may, it seems clear, from the report just issued relative to the accidents which have occurred on the railways of the United Kingdom during the year 1884, that one is never safer than when traveling in a railway carriage. We are admittedly a peculiarly peripatetic people; yet it is impossible to learn without amazement the prodigious number of journeys by railways made in the course of a twelvemonth within these isles. Last year the journeys of season ticket holders alone amounted to 180,000,000; and when to these are added the journeys by ordinary ticket we reach a grand total of nearly 900,000,000. It is not easy to realize the true proportions of this vast aggregate. Still some notion of the practical immunity from danger enjoyed by railway passengers can be gathered from the fact that last year the proportions of killed and injured, from causes beyond their own control, reached in the former case to only 1 in 28,000,000, and in the latter to 1 in every 1,000,000 journeys. But as the amount of traveling by season ticket holders is hard to compute, from the absence of any check upon their movements, the present report relies chiefly upon the exact returns of passenger traffic obtained from the issue of ordinary tickets. Thus we find that last year the number of passenger journeys, exclusive of those of season ticket holders, was 694,991,860, or 11,273,723 more than in the previous year. Calculated on these figures, the proportion of passengers injured during the year, from all causes, was, in round numbers, one in 466,124 injured. This is a slightly higher average than that of the preceding year owing to the fact that, in 1884 there were four unusually fatal accidents. The total number of persons returned to the Board of Trade as having been killed in the working of the railways during last year was 1,134 and the number of injured 4,100. A very proper distinction is drawn between persons who met their death through causes beyond their control and those who, so to speak, courted their own destruction. The railway companies naturally do not want to be made responsible for the culpable and too often fatal folly so frequently displayed by travelers. Excluding, therefore, the 180,000,000 journeys of the season ticket holders, it appears that the proportion of passengers returned as killed and injured respectively during the year by accidents which they could not have prevented was one in 22,419,092 in the one case and 1 in 804,388 in the other. It is interesting and instructive to analyze these figures a little further. Of the 1,134 persons who received fatal hurts 135 were passengers; of the 4,000 injured 1,491 belonged to the same category. This brings us to another subdivision, upon which the railway companies naturally lay great stress. Out of the 135 passengers killed and 1,491 injured only 31 met their death and only 864 received hurts from causes over which they had no control—that is to say, all the rest were guilty in some degree of "contributory negligence."—*London Daily Telegragh.*

The Railway Engines of the United States.

It is not generally known that the export of railway locomotives alone is now large and nearly $3,000,000 in value yearly, and also that these instruments of power, traffic and transportation are doing something to honor the American name in countries rarely visited by an American steam vessel. During the fiscal year ending June 30, 1884, 282 locomotive engines were exported from the United States to foreign countries, valued in the manifests at $2,819,946 or nearly $10,000 each. Of car wheels the number sent was 14,335, value $135,133, and of stationary engines 135, value $171,000. It would be safe to assume the railway motor material exported to be $3,000,000 in all, a very creditable aggregate, and just double the like export of 1881-82, when 133 locomotives were sent out, valued at $1,455,717. These locomotive exports for 1883-84 were to the following countries:

	Number.	Value.
Argentine Republic	65	$906,163
United States of Colombia (and Panama)	49	402,465
Mexico	34	341,865
Brazil	32	296,113
Dominion of Canada	27	208,339
Chili	19	232,569
Australia	14	107,000
Central America	13	113,600
Cuba	14	93,834
Spain	6	63,743
San Domingo	3	13,225
Sweden	3	25,000
Venezuela	2	9,870
England	1	6,616

This distribution is so wide and so well maintained for a series of years that there must be a definite cause to be found, and it is probably due to the one cause of superior quality. In the previous three fiscal years the exports were 99 in 1881, 133 in 1882 and 219 in 1883, each ending June 30th of the year named.

It is shown by the export statistics of the last ten fiscal years that the locomotives sent from the United States to South America were 430 in number, valued at $4,541,165, 203 of these going to Brazil, 84 to Colombia, 72 to the Argentine Republic, 37 to Peru and 31 to Chili. Canada and British Columbia have taken 208, valued at $1,908,129; Mexico 167, value $1,808,699; Australia 115, valued at $1,079,170; Cuba 88, value $772,911; Russia 58, value $778,500; Central America 22, $108,022; Turkey 12, $182,000; Spain 9, England 8 and France 1, these last countries being less advanced in the science of transportation by rail than the countries using American engines, presumably.

It is altogether a remarkable record. Having sought the explanation with some care, I am able to indicate some points of probable importance. First, the American locomotive is built with a different position for the driving shafts communicating the power to the axle, the American being external and the English internal, or between the wheels. The valve faces open internally in a narrow space, difficult of access, in the English engine. In the American they open externally, and are readily accessible for refacing and repairs of the worn cylinder, while to reach the English valve-faces the machinery must be taken apart almost entirely, involving much delay. And because of this costly delay the engines are run until they are much worn, and steam is wasted as well as other risks incurred.

The English claim greater steadiness for the running of these interior connections, but the axle is a difficult piece to make, and it often breaks. Severe accidents, with loss of life, have recently occurred from a broken axle of this sort. Attempts have been made in England toward the use of the American device, but they were not persisted in. But the free choice of Australia has taken 115 of our engines on test of their working efficiency. Brazil over 200, the states of the river Plate 75, and thirty other countries more or less each, all for the same reason, that they proved more efficient in actual work.—*Bradstreets.*

Wages in the Sixteenth Century.

It appears by the books of the corporation of Canterbury, that in the twentieth year of the reign of Edward IV. (about 1481), the regular wages of a tiler were 4*d*. a day. In 1520 we find that a tiler was paid 5*d*. a day; a period of about forty years having produced an increase of one-fifth. From this time forward, however, the change proceeds much more rapidly. In the chamberlain's accounts for the year 1546, we have the following items, by which it would appear that the average price of labor was 8*d* a day:—"First, payd to Thomas Graves, tyler, and his man, for x days tyling about the halle and the chambers, tackying by the day for mete, drynk, and wages, xij*d*., xs. Item, paid to a carpenter for one day's work, mendyng the windows, and the stayers of the same tenement vij*d*. Item, paid to a dawber and hys man for two days dawbyng of the walles of the same house, xij. days, ijs." The last item is somewhat amusing, as it occurs at a moment when so many of our beautiful architectural monuments suffered so much from this same process of "dawbyng" of walls. Only two years after the last entry, in 1548, the price of labor had already risen a penny and twopence a day.—*T. Wright, F. S. A.*

Mixing Mortar.

Mortar in every season ought to be prepared as much as possible under cover, whether it be to avoid the rapid desiccation which takes place in summer, or to obviate the still more serious inconvenience in the rainy season. In the latter case we ought to choose hydraulic lime, slacked by immersion, in preference to that produced by the ordinary mode; and this in order to have it in our power at pleasure to absorb the water contained in the wet sand; without this plan it is impossible to obtain a stiff mortar. In summer, on the contrary, the lime paste is not always sufficient to moisten the sand, which is sometimes hot. It then becomes indispensable to add water, but gradually and with the greatest caution. One would hardly believe without witnessing, how very small a quantity is sufficient to drown the mixture. It is quite evident that a very stiff mortar cannot be used with dry and absorbent materials.

When we have materials of this kind, they must be watered without ceasing, and kept in a perfect and permanent state of imbibition. The whole secret of good manipulation and right employ is condensed in the following precept:—Stiff mortar and materials soaked. Our bricklayers, on the contrary, seem to have taken for their motto, "Dry bricks and drowned mortar."—*L. J. Vicat.*

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ACCORDING to current rumor, October 7 is fixed as the date for the explosion of the mine at Flood Rock, in this harbor. Flood tide in that locality is selected, as the mass of water over the Rock will then be greatest. This will occur about 9 o'clock in the morning.

Engineering, of September 18, in referring to a proposed Russian water pipe-line, complacently remarks that "Russia has taken a leaf out of our book, after we have taken one from hers." The article goes on to state that the pipe-line that was to be run from the Red Sea to Berber was originally suggested by the oil-lines of Russian Baku, and that Russia now proposes to copy the abortive Suakim-Berber scheme by laying a pipe-line, twenty-five miles long, from the Caspian sea, to the desert portion of the Transcaspian railway, for water transport.

We would ask *Engineering*, where does America come in in this question of oil and water pipe-line? According to our best information, oil pipe-lines were an established institution in Pennsylvania some time before Baku oil was recognized as a commercial article; and in any event the present system of American pipe line, is of such an extent as to dwarf the most ambitious effort in the Russian oil field, even though the Russians do use American pumps and American pipe on their existing lines.

As to the Suakim-Berber water scheme, we believe that it required extremely hard work on the part of an American to convince the English war department that it was feasible; American engines were to do the pumping, and American engineers and contractors were at least solicited to do the work. Americans were already pumping oil through 380 miles of pipe, and over elevations of nearly 3,000 feet, and the Egyptian problem seemed simple enough.

New Ordnance Material.

We propose to publish within the last quarter of this year, the full official report of Capt. Wm. H. Bixby, Corps of Engineers, U. S. A., upon the New Ordnance Material of Europe, with all its illustrations.

This valuable document is the result of personal investigation and study, and forms a portion of the official report of Capt. Bixby, "upon turrets, armor-plate, and the mounting and maneuvring of guns of large calibre," made in Europe by order of the War Department in 1881-1882. But the Act of July 7, 1884, known as the Sundry Civil Bill, prohibited the Secretary of War from printing the report as a professional paper, and this valuable information was left to await the chances of some future Congress passing a special act authorizing its publication by the government.

Under these circumstances, and by special permission of the War Department, ENGINEERING NEWS has undertaken to print that portion of the report which relates to new ordnance material, the remainder of it being much too bulky for the pages of a periodical.

This report shows that within the last few years, radical changes have been, or are being made in sea-coast fortifications and their armament; and a glance at the partial index following will give some idea of the importance of the topics to be discussed in our pages between this time and January 1. We propose to publish the entire report within the quarter, so that those who wish to secure it can do so by mailing us the subscription price of three months, or $1.00. We would advise prompt action in ordering the desired papers, for though we will print extra copies, we can not guarantee that the edition will meet all late demands.

The forthcoming article will be treated under the following heads, as abstracted from the full index:

Heavy Guns; wire-wound and ribbon guns.
Non-recoiling Gun carriages; Krupp's non-recoiling muzzle-pivoted. gun-casemate gun, with detail, cost, time of manufacture, service, advantages, disadvantages and possible modifications, etc.; Gruson's non-recoiling minimum embrasure gun-cupola gun; Krupp's non-recoiling trunnion-pivoted gun.
Gun carriages with slight recoil:—Krupp's slight recoil trunnion-pivoted guns; Albini carriage.
Yoke-Mountings for 43-ton gun on ordinary carriage.
Front parapet anchorage.
New muzzle-pivoting mechanisms:—Shaw carriage; Heathorn; King; Krupp; Gruson (old model); Gruson embrasure-ring; Armstrong minimum embrasure carriage, Gruson min.-embrasure carriage.
Disappearing-gun gun-carriages:—Moncrieff and King counter poise; Moncrieff hydro-pneumatic; Labrousse; Armstrong; Razkazoff.
Under-cover loading of heavy guns:—English official system; Armstrong system, for small guns, for 100-ton guns.
Maneuver of heavy guns:—Bibliography of.
New Forms of projectiles:—New Palliser ribbed *abd* jacketted chilled-iron projectiles; Gruson new chilled-steel projectiles.
New Explosives:—Gruson's new explosive of 1881; Miner's powder; Ammonia-nitrate powder.
Accuracy of fire of modern ordnance:—Field guns, heavy guns; rifled mortars or howitzers.
New methods of protection against moisture on wood, stone and metal surfaces:—Celluloid lining for ammunition cases; cork paint for exposed iron-work; cork composition for floors of magazines; ventilation of magazines; Cohausen's psychroscope.

List of Plates to accompany report.

No. 1. Krupp gun-casemate gun of 1878.
No. 2. Test of Casemate resistance.
No. 3. Krupp gun-casemate gun of 1877.
No. 4. Krupp gun-casemate gun, as proposed 1879.
No. 5. Armstrong Albini carriage.
No. 6. Yoke mounting for 43-ton gun.
No. 7. Gruson minimum-embrasure muzzle-pivoted moveable trunnion-bed carriage: C-1880, for 6-inch gun.
No. 8. do; C-1880, for 11-inch gun.
No. 9. do; old model for 6-inch gun.
No. 10. Armstrong under-cover side-loading; for 7-inch barbette guns.
No. 11. do; in firing position.
No. 12. do; plan, elevation, section.
No. 13. do; for 100-ton barbette guns with side traverses.
No. 14. Palliser new ribbed and jacketted chilled-iron projectiles, and target of June 1882.

American vs: English Bridges in Japan.

According to late numbers of the *Japan Daily Mail*, Prof. Waddell has awakened the ire of at least one Englishman, by suggesting in his late work, on bridge-building in Japan, that American designs were best adapted to the needs of that country.

The irate Britisher first denies the assertion that American engineers now lead the world in designing bridge-work; and refers to the structures of England and the Continent, many of them erected before the art of iron construction had made any considerable advance in America, as examples of what other nations have done. He admits that the longest span in Japan—150 feet—is of American build, but insinuates that it fell from faulty design: he says English track and bridges are so well built in Japan that guard-rails on bridges are not necessary, as Prof. Waddell suggests; and the "absolute lack of lateral bracing," which horrified Prof. Waddell, is a trifling matter, as there are no whirlwinds in Japan, etc.

Prof. Waddell replies in a very pungent letter, and taking up his opponent's arguments answers them in detail. In regard to the status of American designers, he remarks that all bridge-work done more than about 15 years ago must be ignored in comparing the merit of designs. No English engineer would to-day reproduce the Menai or the Victoria tubular bridges, though they were regarded as wonders when erected. Actual inspection of English bridge-work in Japan shows a quality of workmanship that is even worse than the cheapest highway bridges of America; one case mentioned, a railway bridge, has its bottom chords so warped that "the floor-beams bear on both sides of the same," shims of ⅛ and ¼ inch iron are freely used, and there are open joints in the top chord that paint will not hide. As to guard-rails, the floor-beams on the English bridges are so weak and so far apart that in case of derailment the destruction of the bridge would be certain, and the Professor remarks that a Japanese typhoon is quite as effective in upsetting a bridge as a whirlwind in other countries. In regard to the American bridge referred to as destroyed, an account of the accident published at the time, shows that the truss was lifted from its piers by an accumulation of drift under it in an unprecedented flood; but was so little injured by the rough handling it received that it was replaced, with the addition and repair of a few of its members, and has been doing excellent service since 1882.

We are glad to see that there is an American engineer in far-off Japan who has the public spirit to advise the people of that country in a matter that is evidently to their advantage, and has also the energy to defend his position when attacked. With Prof. Waddell, we believe that for economic use of material, proper adjustment of members, a correct diagnosis of stress and ease and speed of erection, the system in use in this country is immeasurably superior to the rivetted lattice construction that is still a favorite in England and on the Continent.

But in the structures described and criticised in Prof. Waddell's work on Japanese bridges, we regret to see that the English builder has evidently added bad workmanship to cheap

material and faulty designs. The Japanese have been victimized commercially as well as deceived professionally. Though the objector to Mr. Waddell's statements hints that the American "long-span" bridge was a failure, it turned out to be otherwise; and even he must admit that no rivetted bridge once pushed off its piers and swept down stream could ever be replaced so as to be of any future value. Our system has expanded to its present form of excellence from a type first suggested and made necessary by scarcity of means, distance of transport and the requirement of speedy erection by comparatively unskilled labor. These were the original conditions, and while they now seldom exist, the lessons thus taught have borne fruit in a system of bridge construction that has drawn unqualified praise even from English engineers, and among these we might mention one of the most eminent, Mr. Baker, now building the Forth Bridge, which in boldness of design is only approached by the work of our own engineers

We have the type of bridges wanted in Japan, as elsewhere where self-interest will outweigh foreign influence; we have the material and the men to turn it into finished structures, and on behalf of these makers we thank Prof. Waddell for opening the eyes of another distant people to the advantages to be derived from their use.

The Sewers of San Francisco, Cal.

The *San Francisco Chronicle*, of September, 15th, devotes a page or more to an exposé of the sewerage of that city. According to the statements there made the present condition of the drainage of San Francisco is deplorable, and moreover dangerous. Many of the sewers are clogged with mud and refuse for half their depths; house-drains enter below this mud line and are choked up: certain sewers discharge into others whose floor is 2 feet higher than the entering sewer, and in one remarkable case a 5 ft. sewer "discharges" into a 14-inch pipe.

Though the average reporter on the daily press is prone to exaggerate existing evils, and to seek out or amplify items that can be used in startling head-lines, in the present case, there seems to be just cause for complaint. While not so stated, the San Francisco papers have probably just discovered that their city is suffering from a complaint common to most cities that started their drainage on hap-hazard methods, without system, and trusting to the generation to come to remedy their blunders.

Report of the Philadelphia Water Department for 1884.

The report for 1884 shows a gratifying improvement in the efficiency of the works. The total pumpage for 1884 averaged 69,658,969 gallons per day, or 72½ gallons per head, with an estimated population of 960,000. The maximum pumpage for any one day was on May 28, with 95,686,444 gallons, and the least, on February 10, with 46,163,058 gallons. The average net cost of this pumpage, per million gallons raised 100 feet high, was $5.54 in 1884, a reduction in cost of nearly 17 per cent. in two years.

The report contains a lengthy review of the past and present investigations into danger from pollution of the present water supply. The conclusion arrived at is, that though the Schuylkill water might be secured against sewage contamination within and near the city, it would still carry matter discharged into it far above the city, and would still be turbid at seasons; filter-beds, besides being expensive to build and maintain, are not available until adequate storage and distribution facilities are supplied.

The surveys for future water supply, commenced in 1883, will doubtless stand as the most enduring monument of the present administration of the department. From the report of Mr. Rudolph Hering, the engineer in charge of these surveys, nine-tenths of the field work has been covered, but some time will yet elapse before the valuable information gained can be put in available shape. The work done by Mr. Hering and his assistants is minutely detailed in his report to the Chief Engineer. It includes surveys of all the available conduit lines to the Perkiomen water-shed and to the Delaware river; geological profiles of these lines; sanitary surveys of the water-sheds investigated, and hydrographic and topographical surveys. The Delaware water-shed required extensive triangulation as the U. S. Coast and Geodetic and the Pennsylvania State Geological Surveys did not cover this territory. This entire water-shed will be mapped on a scale of 400 feet to the inch; 137½ square miles of this country were plotted in the field to scale; three miles per week, on the scale above given, being covered by one engineer and a rodman. In this field plotting, the instruments used were a field-table 15 inches square and with a universal joint and tangent screw, mounted on a light tripod. The plotting sheets were ruled to one-quarter inch squares, each representing 100 square feet. Main lines were run with the transit by magnetic courses and stadia distances in circuits of one to three miles and tied to the trigonometrical stations when possible. These lines were immediately plotted to scale on the table standing beside the transit. Levels were taken partly by spirit-level on the transit and partly by vertical angles, from benches established by the leveling party proper; they were found to generally check within one foot in a three-mile circuit. These levels were also plotted on the sheet and contours drawn on the ground. Buildings, roads, streams, etc., were located by transit angles and plotted. Colored pencils were found of great assistance in marking certain features, as blue for water-courses, green for limits of woods, and yellow for roads. In leveling for the Delaware conduit, the rate of error for the 97½ mile line was found to be 0.0066 feet per mile, and for the 73-4 mile line, it was 0.0016 feet per mile.

The Sanitary survey of the Schuylkill Valley is made the subject of an elaborate and careful report by Assistant Engineer Dana C. Barber. This was a somewhat difficult undertaking as the manufacturers and others on the banks of the river were not likely to assist the investigator into the subject of water pollution. This survey extends from Pottsville to Philadelphia, and each town or village and each tributary is separately examined and reported upon. The thoroughness of this report of Mr. Barber makes it a model of its kind and gives an excellent idea of the numerous and often unexpected sources of pollution along a stream of the character of the Schuylkill.

The Operation of the Northwestern Reservoir System.

J. S. Pyle, of St. Paul, Minn., who contributed a very interesting article to *Harper's Magazine* last year on the purpose and plan of the reservoir system, now writes to *Bradstreets*, detailing the results as far as tested.

This vast work, commenced in 1882, contemplates the storage of the surplus water of the upper Mississippi and its tributaries, and the use of this stored water to supplement the natural dry season flow. Three of the five reservoirs designed were completed last year, and are now ready for operation; the most important is the dam at Lake Winnibigoshish, with a length of 1,100 feet, and height above low water of 14 feet. Its storing capacity is 40,000 million cubic feet, and the average annual supply from the region tributary, is about 22,000 million cubic feet. The Leech Lake dam is the second, and is 3,500 feet in length, and 4 feet above low water; the storage capacity is 22,000 million cubic feet, and the annual supply is about 13,000 million cubic feet. The Pokegama dam is 300 feet long and seven feet high; it has a capacity of 3,500 million cubic feet, and an annual supply largely in excess of these figures; this last is the lowest of the dams on the Mississippi proper, being 350 miles from St. Paul. A fourth reservoir is under construction on Pine River. It will be 17 feet high above low water, and store 7,000 millions of cubic feet of water.

The three dams first named were practically finished in August, 1884, and the storage of water commenced in October of the same year, and by this storage is meant the retaining of all water above what was necessary for purposes of commerce and ordinary navigation. Between October, 1884, and August 10, 1885, when the sluices were first opened, the accumulation of water in the reservoirs was about 36,000 millions of cubic feet. This is theoretically equivalent to a discharge of 3,000 cubic feet per second for a period of 138 days; the other reservoirs when finished will add at least 2,000 cubic feet per second for from 90 to 100 days. In a dry season it has been found by actual experiment that the united volume of the Mississippi and Minnesota, near St. Paul, was only 5,800 cubic feet per second.

The actual work of the three reservoirs now in operation is thus recorded:—The gates were closed last fall to retain all surplus water; upon the opening of spring navigation, the gates were opened slightly and this discharge kept up until August 10, 1884. From this last date the flow was gradually increased until the 29th, when it had reached a discharge of 3,000 cubic ft. per second, and it has been maintained at that rate since. The natural flow from the basin above Pokegama would be only 750 cubic feet at this time, or about one-fourth of the quantity now passing. The average low water discharge of the Minnesota River is 1,300 cubic feet, so that the reservoirs have added nearly two Minnesota's to the low water stage of the Mississippi at St. Paul. The lowest measured discharge of the St. Croix river is 1,800 cubic feet, and the low water discharge of the Mississippi at Winona is less than 11,000 cubic feet per second.

A discharge of 4,500 cubic feet per second will fill a channel 750 feet wide, 4 feet deep and flowing one mile per hour; or 3,600 cubic feet would supply a channel 800 feet wide and 3 feet deep, flowing with the same velocity. The gauge-records taken after the opening of the reservoir gates showed at St. Paul that the river fell $1\frac{3}{10}$ feet from August 1st to August 23d, from the 23d to the 31st it remained stationary, then the water rose one-tenth foot and so remained. On the Mississippi, at Grand Rapids, the gauge showed 1.15 feet in the channel on August 9th, 4.25 feet on August 15th, and 5.95 feet on August 30th, which last stage has been maintained to the present date. This is the same in effect as at other points and the gain is solely due to the surplus water from the reservoirs, and the test of the three reservoirs is certainly a success.

To Major Chas. J. Allen, U. S. Engineer belongs the credit of having carried out the gigantic works assigned to him. The total appropriations so far amount to $585,000, and of this $16,000 was used in compensating Indians for land damages. Up to the present date the water-level has been kept $3\frac{5}{10}$ feet above its usual stage at this season.

FRONTINUS, an ancient writer on the water supply of Rome of the Romans, shows the total quantity poured into that city by its various superb aqueducts was equivalent to a stream 20 feet wide and 6 feet deep; or in volume, 332,000,000 gallons daily. With the estimated population of Rome at the time referred to by Frontinus, this was equal to 332 gallons per capita per day

Railroads in Italy.

A statistical report for the year 1883 issued by the Minister of Public Works of Italy, gives some interesting information as to the extent and position of the railroads in that country. The roads are divided into three classes: 1st, those constructed by the State under laws previous to the one of July, 1879: 2nd: Those comprised in the complimentary system provided for by the above law: 3d: Those constructed by private companies, and including steam tramways.

The first class has an aggregate of 1,138 miles, with a total cost of $974,04,756, made up by $64,126,026 for works, $6,816,000 for rolling stock, telegraph lines, and working expenses, and $23,762,730 outside the direct management of the State. All these lines are in operation with the exception of a gap four and a half miles long on the line between Catania and Valermo (Sicily), on which is the Marianopoli tunnel nearly four miles long, which is to be completed this year.

The second class includes standard gauge lines of (*a*) ordinary and (*b*) special construction, and (*c*) narrow gauge roads.

	a.	*b.*	*c.*	Total.
Miles constructed	715	2,094	923	3,732
" surveyed	614	1,784	85	2,483
" under construction	290	736	29	1,055

In July 1884, the length of lines under construction was 1,140 miles.

The third class consisted of 918 miles of railroad, of which 162 miles were open, 318 miles under construction, and 437 miles upon which work had not commenced. The steam tramways were of the following extent:

	Length in June.	
	1883.	1884.
Miles open and working	929	1,029
" under construction	219	281
Total	1,148	1,310

It is stated that several accidents have happened on these tramways, 229 having occurred in the year from June 1883, to June, 1884.

There were 181 locomotives, 457 passenger cars, and 1,762 freight and cattle cars.

The report includes extensive tables of train mileage, running expenses, receipts, traffic and accidents.

PERSONAL.

PETER TOWNSEND died Sept. 26, at his residence in New York City. Mr. Townsend was born May 13, 1803 in Chester, Orange County, N. Y., and was connected with iron manufacture throughout his long life. He built large works at Brady's Bend, Pa., and is said to have there rolled the first bar of American railroad iron.

J. FOSTER FLAGG, Mem. A. S. C. E., sailed for Cuba on the 1st inst., in the interests of a private Water Works Construction Company, for the purpose of investigating the merits of a water supply for Santiago and other places.

N. HUTIN was nominated on September 4, by the Council of Administration, as Engineer in Chief of the Panama Canal. The *Bulletin du Canal Interoceanique*, of September 15, does not inform us whether M. Dingler, the late chief, has been superceded or not, nor what has become of M. Marbeau, or Herr von Hammer.

ROBERT E. MORRIS, late Assistant Engineer, First Division of the New Croton Aqueduct, was fatally injured on September, 24th, at Shaft Zero, by the car jumping the track on the incline; he died on the following day. Edward S. Larned, rodman, and a laborer were severely bruised at the same time. Mr. Morris was the son of Dr. Morris of Ogdensburg, N. Y.; he came from the public works of the State of New York, entered the service of the Aqueduct Commission in June, 1884, and was gradually promoted to his late position. He was in the twenty-fourth year of his age, and highly commended for his fidelity to duty and and professional services.

DR. GARRETT B. LINDERMAN, General Superintendent of the Bethlehem Iron Company, President of the Lehigh Valley National Bank, and a Director of the Lehigh Valley Railroad, died at his residence in South Bethlehem, Penn., September 28th, of a complication of diseases.

MESSRS. FOX AND DRUMMOND of 160 Broadway, N. Y., have been appointed selling agents for the Mellert Foundry & Machine Co., of Reading, Pa., which company has been enlarging its capacity to meet the rapidly increasing demand for its specialties.

THE following circular explains itself:—

I beg to inform you that all business of the Judson Powder Co., will be transacted at the offices of "The Atlantic Dynamite Co., 245 Broadway, N. Y., on and after this date. All orders and other communications should be directed to the Atlantic Dynamite Company, and all checks made payable to their order. I am now with the Atlantic Dynamite Company, associated with Mr. Geo. S. Small, in the same capacity as formerly occupied by me in the "Judson Powder Co." The Judson Powder will be manufactured at Drakesville, N. J., as usual, and the quality will be the same as heretofore. All orders will be filled under my personal supervision as formerly, which will ensure uniform quality and prompt delivery. A continuance of your patronage is respectfully solicited. Very truly,

JOHN C. SCHRADER.
Late General Agent Judson Powder Co.

CORRESPONDENCE.

Street Monuments.

NELSON, NEBRASKA, September 25, 1885.

EDITOR ENGINEERING NEWS:—I wish to build some monuments for working intersections of streets; they are to be below the surface: and of concrete, sand, cement and soft magnesian limestone. I would like to ask some of your readers who have had experience in such work for the proper proportions of each.

Respectfully,
E. A. D. PARKER.

The Windsor, Conn., Locks Bridge.

NEW YORK, Sept. 28, 1885.

EDITOR ENGINEERING NEWS:—In your last paper you described the Windsor Locks Suspension Bridge, which is nearly correct except one clause; namely, "Contractor Roebling who built the Brooklyn Bridge has taken the work at $55,000. This is a mistake, Mr. Roebling has not taken this contract, neither does he take any contracts of this kind. The undersigned is the Contractor and the Engineer.

The wire is furnished by John A. Roebling's Sons & Co., the other material is furnished by other parties. The J. A. R. S. Co., have furnished the wire for a number of Suspension Bridges built by the undersigned.

Yours truly,
J. W. SHIPMAN.
59 Tribune Building.

ICEBERG DUST.—One of the most interesting facts contributed by Professor Nordenskiold to popular science is contained in his account of his examination—when about eighty degrees north latitude, before reaching Parry's Island, to the northwest of Spitzbergen—of the snow which covered the icebergs, and which had come from still higher latitudes. He found it strewn with a multitude of minute black particles, spread over the surface or situated at the bottom of little pits, a great number of which were to be seen on the outward layer of snow; many of such particles were also lodged in the inferior strata. This dust, which became gray on drying, the Professor found to contain a large proportion of metallic particles attracted by the magnet, and capable of decomposing sulphate of copper. An observation made a little later upon other icebergs proved the presence of similar dust in a layer of granular crystalline snow situated beneath a stratum of light fresh snow, and another of hardened snow. Upon analysis, the Professor found this matter to be composed in varying proportions of metallic iron, phosphorus, cobalt and fragments of diatomaceæ.—*New York Sun.*

OUR MATHEMATICAL COLUMN.

SELECT any number, multiply it by 6. add 48, divide by 3, add 3755, divide by 2, subtract the number first selected, and the result will be something that will surprise you.

JOHN TIPPER wrote the following astronomical lines about the year 1709, and even now they are useful to assist in keeping in mind the order of the constellations of the zodiac:

Between the north and south, all round the sky,
Just in the midst twelve constellations lie
We call the signs. And first the Ram begins,
The Bull next follows, then the heavenly Twins;
The sea Crab, Lion, and the Virgin tender,
Then comes the Balance, Scorpion, and Bow-bender:
After him the Waterman, then Fishes twain
Do bring you round unto the Ram again.

LET H be the number of horse powers to be transmitted by a shaft, n the number of revolutions per minute, and T the allowable working torsional strain upon the material in pounds per square inch. Then the proper diameter of the shaft in inches may be computed from the formula,

$$d = 69 \sqrt[3]{\frac{H}{n\,T}}$$

This formula shows that the diameter of a shaft should be the greater the less its velocity.

No. 2 of Vol. 2 of the *Mathematical Visitor*, edited by Artemas Martin, bearing the date 1883, has just been published. This journal is entirely devoted to the solutions of problems in higher mathematics. The indefatigable labor of the editor has rendered the *Visitor* an important addition to American mathematical literature.

PROBLEM 16. An engineer being in want of a beam 20 feet long capable of sustaining nine tons uniformly distributed with a factor of safety of ten when supported at its ends, sent to a timber lot of yellow pine for a log from which to cut the beam: required the diameter of the log needed. The log is to be the smallest one necessary, and is not to be used in its original form.

Solutions have been received from Felix Freyhold, Washington, D. C., S. P. Mitchell, North East, Md., and F. W. D., Port Jervis, N. Y., giving the answers 9.1 inches, 21.5 inches and 8.9 inches respectively. The following is the solution by Mr. Freyhold:

For rectangular beams uniformly loaded the formula is $W = n \dfrac{R\,b\,d^2}{6\,l}$, when

W = total load in pounds = $9 \times 2{,}000 = 18{,}000$.
n = factor of safety = 10,
b = breadth of beam in inches,
d = depth of beam in inches,
l = length of beam in inches,
R = Modulus of rupture of wood taken here as 9,000 pounds.

$$18{,}000 = 10 \frac{9000\,b\,d^2}{6 \times 20 \times 12}$$

$b\,d^2 = 288$

To cut the strongest rectangular beam from a given circular log b must be taken to d as 1: $\sqrt{2}$ or $d^2 = 2\,b^2$.

$2\,b^3 = 288$ $b = 5.24$ in. $d = 7.48$ in.

If D = diameter of log, then

$$D = \sqrt{b^2 + d^2} = \sqrt{27.4576 + 55.9152}$$

$D = 9.13$ in.; the required diameter.

Southern Society of Engineers.

A meeting of civil engineers, pursuant to call, was held in the office of J. Francis LeBaron, C. E., Jacksonville, Fla., on the 24th inst. The following gentlemen were present:

Ex-Lieutenant-Governor W. H. Gleason, Eau Gallie, Fla.; J. Francis LeBaron, civil engineer, Jacksonville; J. E. Bozeman, civil engineer, Salem, Ala.; L. J. Barbot, civil engineer, Charleston, S. C.; T. W. Simpson, civil engineer, Roanoke, Va.; John Payne Pratt, civil engineer, Starke post-office, Fla.; C. F. Smith, civil engineer, International Railroad and Steamship Company, Jacksonville, Fla.; A. Baur, civil engineer, Florida Land and Mortgage Company, Jacksonville; Blair Burwell, chief engineer, Jacksonville, and Atlantic Railroad, city; Ned. E. Farrell, chief engineer and superintendent Santa Fe Canal, Waldo; H. S. DuVal, State engineer, Chattahooche, Fla.; R. N. Ellis, city engineer and superintendent water-works, Jacksonville, Fla.; M. C. Kollock, assistant engineer Savannah, Florida and Western Railroad, Savannah, Ga.; P. W. O. Koerner, civil engineer, Ellaville, Fla.; Wm. W. Lyons, civil engineer, Jacksonville, Fla; W. C. Brown, chief engineer

Tampa Railway and Steamship Company, Tampa, Fla.; Zeph Harrison, civil engineer and surveyor, city; E. F. Smith, civil engineer and surveyor, city; B. Carter, chief engineer Jacksonville, Tampa and Key West Railway, city; H. W. Reed, master of roadway Savannah, Florida and Western Railroad, Waycross, Ga.; A. W. Barber, United States assistant engineer, city; Thomas N. Anderson, civil engineer and contractor, city; C. F. Hopkins, county surveyor, city.

The following were elected officers for the ensuing year:

President—H. S. DuVal. of Florida.

Vice-President—L. J. Barbot, of South Carolina; M. C. Kollock, of Georgia; J. E. Bozeman, of Alabama; W. H. Gleason, of Florida.

Secretary and Librarian—J. F. LeBaron, of Florida.

Treasurer—R. N. Ellis, of Florida.

Directors—Ned. E. Farrell, of Waldo; Captain C. F. Smith, of Jacksonville: P. W. O. Koerner, of Ellaville; S. B. Carter, of Jacksonville; A. W. Barber, of Jacksonville.

Letters were read from thirty-eight civil engineers who were unable to be present, but endorsed the movement and promised their support. After the appointment of several other committees. and the drafting and adoption of a constitution and by-laws, the society adjourned to meet regularly the first Tuesday after the first Monday of every month at the office of Mr. LeBaron.

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 203*).

With curves the inside rail should be levelled first and then the outside rail raised above it according to the proper elevation. Some trackmen reverse this rule and raise the outer rail first, but in no case can they gain by so doing and can readily lose if they do not happen (for it is a case of happen) to get the outer rail correct at the start. Such a proceeding is putting the cart before the horse, as the inside rail is grade, higher than which the outside rail is to be raised. If the outside rail is very low then the inside rail should not be raised quite to grade, remembering that when the outside is raised later, it will bring the inside rail up too, since in raising the ties rest on their ends. Again, if the outside rail is very irregular the proper allowance for that must accordingly be made, or else bring the whole curve to a fair surface before finishing. If the raise is to be considerable it may be necessary to do it with two or more lifts, depending on the frequency of trains.

On double track it is best to raise against traffic, as it is safer and easier to have trains run up than down the temporary steep run off.

In winter when the ground is frozen, the ballast, unless perfectly porous, is unequally heaved by frost. Since it is then impossible to tamp recourse must be had to shimming low spots, as the putting of blocks under the rail is called, or in extreme cases adzing down the ties under the high places. This latter alternative should be resorted to only in extreme cases when it is impossible to block upon the adjoining ties to correspond, as a tie once adzed is ruined and must be replaced next season, even if it is not troublesome during the winter.

Shims can be manufactured in the shops and sent out, or else made by the trackmen as needed. In the latter case they take a straight grained hard wood tie (oak preferred) saw it into blocks about 8 inches to 10 inches long, and split these with a hand axe into pieces of such thickness as is required. When they are manufactured in the shops, of any convenient hardwood, 6 inches wide and in thickness varying from ¼ inch to 1½ inch are sawed into pieces 10 inches long and then drilled according to templet with two 1-inch holes, such holes being set diagonally opposite each other according to Fig. 117, where the dotted lines show the edges of the base of rail.

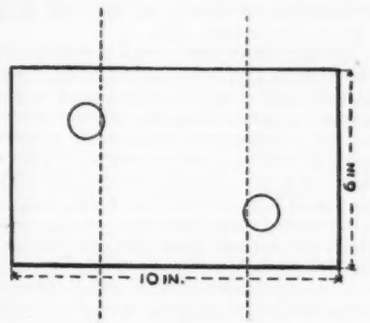

FIG. 117. SAWED SHIM.

Unless the split shims are hand-drilled for a spike hole, they must be placed under the rail diagonally between the spikes, since to spike through them would break them. The advantages of sawed shims are cheapness, since any wood may be used, whereas only the best of ties can be split; better bearing; greater security against slipping out of place; and the thicker shims can be used again. Shims used on bridge ties should always be machine made. No shim thicker than 2 inches should ever be used and in case track heaves so badly as to require more, a piece of plank should be spiked to the tie and shims put on that in the usual manner; in fact when blocking gets over 1 inch high, side braces should be spiked against the rail.

The practice of blocking underneath ties should be forbidden except in very bad cases, because it is better to let the ties rest in the same bed it has made, and because there is danger that the blocks may be left in when spring comes.

If track is laid in clay it will heave very badly; in extreme cases I have seen tie rods raise 20-inch from their bed, and track supported entirely in the center. In such an event the only remedy to prevent ties from breaking and keep track safe is to block up underneath with plank and gradually remove the latter as the track settles. Sometimes in spring when frost is coming out, ties in mud ballast will abruptly settle in spots to the extent of several inches. The best thing for a temporary job is to block up underneath with plank, fence boards or anything handy, then dig out wet mud and replace it with fresh cinders, which seem to act like a sponge and are superior to gravel for such work.

As soon as the frost leaves the ground all shims should be taken out, and those which can be used again piled up for the next winter, and low ties tamped up to a good bearing. Winters when snow is permanent are better for track than those without it, and steady cold is less severe than alternately spells of thaw and freeze. As frost comes out, track needs most attention, as it will frequently, if the ballast be poor, rise or sink considerably in a few hours, and this weather is also most trying on rails as they are then apt to break either from physical changes in the metal itself or the uneven support they are forced to receive.

On the majority of roads the questions of drainage and ditching do not receive adequate attention, but their importance should be diligently impressed on the minds of every one. In yards the best plan is porous ballast, and if these are placed where water collects, wells covered with a grating should be sunk and either connected with a sewer or else dug deep enough below frost time to act as a cesspool. Into these wells surface drains can be run. Outside of the yard the regular side ditches should be constructed as previously illustrated in the cross-section diagrams. Some pains should be taken on the part of the foreman to see that the men cut the ditch true, its back edge straight, sloped from the tie ends uniformly and bottom even leaving no pools or ridges which will hold water. It requires no more time to make a ditch properly, only more care.

As a rule rails are not handled carefully enough. Abroad where rails are bought under close contracts it is expressly stipulated that they shall not be unloaded except by skids.

In this country they are too often thrown off the cars in to piles, bending or injuring many. Before laying, such bends should be straightened by a rail bender. When old track is repaired with new steel rails the road bed should be surfaced and rotten ties replaced before doing so. Rails represent a large sum of money and the permanent damage done to them by laying them on a poor foundation can soon amount to one-quarter of the original outlay. In case ties are cut and cannot be changed they should be adzed to give the rail an even bearing. But if new steel is introduced for ordinary repairs it is better to lay the new steel all together and use that which is taken out for patching, so that rails of the same height are kept by themselves, In laying rail ample allowance should be made for expansion. A 30-foot rail will expand ¼-inch with a change of 100° Fahrenheit. In case steel has to be cut, the bolt holes must be drilled, iron may be punched but steel can not, as it destroys its tenacity. When a cut rail is used the full complement of bolt holes should be put in so as to make the joints secure.

It is not every man who can drive a spike properly. Spikes should be driven straight and snug up against the rail base, and this should be obtained naturally and not by a last blow on the side of the spike head so as to bend it over against the rail and give it the appearance of a fit. As a guide on starting, the lip of a spike should be placed against the side of the rail head, and then with straight blows the spike will be driven properly.

Unless bolts are kept tight joints will not stay up. When rails, splices and bolts are new, the latter will need retightening shortly after their first setting, that is, when the scale is knocked off and the bearing surfaces have worked to fit. With old track the gang should go over the section at least every spring and autumn and give all the bolts a general overhauling, and between these times the track walker can take care of them.

Track on bridges and approaches should be maintained in the best possible condition, the alignment especially being kept perfect. At each end of a bridge the track should be most carefully tamped so as to have as nearly as can be the same spring or elasticity as the bridge itself. It is very damaging to the bridge to have a train drop on it as it were from higher track, or to strike it by its being raised above the approach. If a bridge is on a curve the outside rail must be elevated precisely the same as the rest of the curve, while if it is at a point of curvature (something to be avoided in location) the elevation must be run out according to the rule previously given by means of graduated shims, which shims should be substantial affairs nailed to the floor beams or ties. In other words every care should be taken to have trains pass on and off without jar, as such jar is very detrimental to the structure. A neat and quick way to line track on a bridge is to determine at both ends, and intermediate points also if the bridge is long, where the outer edge of one rail flange is to be; between these points snap a chalk line and then the rail can be spiked so that the edge of the flange just cuts this line, after which the other rail can be laid to gauge.

TO BE CONTINUED.

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Accurate Chaining.

BY H. W. CLARKE, SYRACUSE, ENGINEER-IN-CHARGE, N. Y. AND PENNA. BOUNDARY SURVEY.

Supplementary to Mr. Baker's interesting paper on chaining, in the issue of the NEWS of September 19th., I will submit the following:

1. The links of a chain which is drawn day after day upon rough ground, through bushes, among stumps, over logs and rocks, will soon each acquire a permanent bend. Most of these will be comparatively slightly bent, and generally the length of the chain is not perceptably affected, *until a systematic straightening* of links is undertaken. Every time a bent link is straightened, it is lengthened. It is, therefore, policy for the surveyor in the field, when he finds the links in his chain becoming bent, to leave them so until he can test the chain after overhauling it.

The chain used upon the reconnaissance, of this boundary, was a well made "4-pole" steel chain, No. 12 wire, oval rings, brazed joints, ordered for the purpose, and was handed constantly by the same chainmen, (who were already trained at the start), over the roughest of ground, on a line of nearly 250 miles. It increased in length 0.3 ft., 60 to 70 per cent. of which was in straightening bent links. As an extra case, I will mention that of a 100-foot steel chain, No. 12 iron, oval links, brazed joints, which had been in use for some time by miscellaneous chainmen, in rough measurement, without correction except by occasional test for length, and the links had all become badly crooked. Its apparent increase in length in all that use, was comparatively slight. Wishing to test a long measurement on the boundary, on nearly level ground, partly wooded, I took this chain and had the links carefully straightened.

Its length was tested upon a plain surface before this was done; the *spring* of the chain between ordinary and extreme tension (muscular), was nominal. When tested after correction, the chain was found to have lengthened under the operation 0.11 ft. and the increase was distributed equally over each half of the chain.

The same will occur with a wire although in a less degree, dependent of course upon its size.

(3.) (6.) (7.) In every community will always be found men who "know it all," perhaps have played axmen in some backwoods survey, or have pulled chain occasionally. Such "experts" are generally called in by the client to assist the surveyor in the survey of his farm. The rule with them on level ground, is to hold the handles of the chain at the heads of the pins with so little tension, that the greater proportion of the length of the chain is raised from the ground; and doubtless it is for the purpose of adopting the length of the unit to such precision, that the new U. S. 66.06 rule is adopted. In such case, the leading chainmen, grasping the head of the pin with the same hand which holds the handle of the chain, with the partially tightened chain as a radius, stabs the pin into the ground, and goes on; or, in descending a slope, raising the end of the chain to the height he thinks proper, with the same hand drops the pin point downward, depending upon its weight to set it. The best course for the surveyor, when he finds himself temporally supplied with such helpers, is to quietly promote the most knowing one to transitman, and let him carry the instrument, while he himself takes one end of the chain; he can then more efficiently supervise the chaining.

Such chaining as I have referred to is a very fit accompaniment to instrumental work with the ordinary compass. With a probable error of $\pm$ *a rod*, a fraction of an inch of error in the chain is of no account. But when an instrument of precision is used for angles and lines, the utmost pains should be taken in these miscellaneous surveys to insure accuracy in the measurements, either carrying the chain and setting the pins properly or, what is better, by the use of a lighter, simpler, and more reliable measuring tool.

Extracting Metals by Electricity.

Prof. T. Sterry Hunt, of Montreal, read a paper before the late meeting of the Mining Engineers' in Halifax, on a new smelting furnace invented by Messrs. E. H. and A. H. Cowles, of Cleveland, Ohio.

In the apparatus devised and now employed by the Messrs. Cowles, a column of fragments of well calcined charcoal so prepared and arranged as to present the requisite electrical resistance, is imbedded horizontally in finely pulverized charcoal and covered by a layer of the same material coarsely broken, the whole being placed in a box of fire brick, covered with perforated tiles and opened at the ends to admit two carbon electrodes one inch and one-half in diameter. Through these the current from a dynamo-electric machine of thirty-horse power is now made to traverse the central core of carbon, whereby such a temperature is at once produced that platinum and iridium may be instantly melted therein; and the most refractory oxides are not only fused and volatilized, but reduced to their elemental state with formations of carbonic oxide gas. If alumnia in the form of granulated corundum is mingled with the carbon in the electric path aluminum is rapidly liberated, being in part carried off with the escaping gas, and in part condensed in the upper layer of charcoal. In this way are obtained considerable masses of nearly pure fused aluminum and others of a crystalline compound of the metal with carbon; when, however, a portion of granulated copper is placed with the corundum, an alloy of the two metals is obtained, which is probably formed in the overlying stratum, but at the close of the operation is found in fused masses below. In this way there is got, after the current has passed for an hour and a half through the furnace, from four to five pounds of an alloy containing from 15 to 20 per cent. of aluminum and free from iron. On substituting this alloy for copper in a second operation a compound with over 30 per cent. is obtained.

Already the small experimental plant with a 30 horse-power dynamo is producing daily over five pounds of aluminum in the form of a rich and brittle alloy, which, by suitable additions of copper, is converted into different grades of aluminum bronze. The remarkable qualities of these are so well known, that it is only their great cost hitherto which has prevented their more general use in the arts. They are now offered for sale at Cleveland on a basis of $5 a pound for the contained aluminum.

When silicious sand mixed with carbon is placed in the path of the electric current, a part of it is fused into a clear glass and a part reduced with a production of considerable masses of crystalized silicon, a portion of this being volatized and reconverted to silica. By the addition of granulated copper, there is readily formed a hard brittle alloy, holding 6 or 7 per cent. of silicon, from which silicon bronzes are cheaply made.

The direct reduction of clay gives an alloy of silicon and aluminum, and with copper a silico-aluminum bronze, which appears to possess properties not less valuable than the compounds already mentioned. Even boric oxide is rapidly reduced with evolutions of copious brown fumes of boron, and the formation in the pressure of copper of a boron bronze, which promises to be of value; while under certain conditions crystals of what appears to be the so-called adamantoid boron are formed. In some cases, also, crystalline graphite has been produced, apparently through the solvent action of aluminum on carbon.

Remarkable results are got by alloying small quantities of aluminum with an admixture of copper and nickel. One of these compounds broke with a strain of 111,000 pounds to the square inch, with an elongation of 35-100. With 10 per cent. of aluminum, the bronze broke with 109,000 pounds.

An addition of from 2 to 5 per cent. of aluminum to brass greatly increases its tensile strength, and renders it less liable to oxidation, while 15 or 20 per cent. of aluminum with copper yields a brittle compound.

An addition of 10 or 15 per cent. of copper gives to pure aluminum a great increase of hardness and tenacity, forming an alloy which may have a wide application.

It may be added that the difficulties in the way of gathering together the reduced aluminum without the aid of copper, promises to be overcome at an early day, so that one may expect the cheap production of such alloys and of pure aluminum.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY JAMES R. CROES, M. SOC. C. E.; INST. C. E.

(CONTINUED FROM PAGE 203)

DCCLXXXI.—WADSWORTH, OHIO.

Wadsworth, Medina Co., O., is in lat. 41° 10′ N., long. 81° 50′ W. Water-works were built in 1882 by R. Weaver as a private enterprise, the supply being taken from two springs, the water from which is collected in two reservoirs, one 16 feet square and 20 feet deep, and the other 32 feet long, 24 feet wide and 26 feet deep, constructed of heavily spiked timbers, and being 1¼ miles distant from and 84 feet above the square in the center of the village.

Distribution is by 3½ miles of Wyckoff wood pipe with 128 taps. There are no fire-hydrants in use. The works have cost $6,000. The yearly expenses of maintenance are $100 and the receipts $800. Service pipes are of galvanized iron. The daily consumption is unknown. The population in 1880 was 1,219. R. F. Weaver owns the works, and A. L. Corman is secretary.

DCCLXXXII, WEBSTER CITY, IA.

Webster City, Iowa, is in lat. 42° 20′ N., long. 93° 40′ N., is the county seat of Hamilton Co. Water-works were built by the city in 1883, after plans of W. H. Burnham taking the supply from ground water. From an open well 8 feet in diameter and 40 feet deep the water is pumped by a double-acting pump of 5 inch bore and 15 inch stroke, driven by a windmill 25 feet in diameter, made by the U. S. Wind Engine and Pump Co., to a wooden tank 20 feet in diameter and 30 feet high, set on a timber trestle 30 feet high, holding 99,200 gallons at 70 feet above the business part of the town.

A Knowles pump of 14-in. steam and 7-in. water cylinders, and 12-in. stroke is used in calm weather and for direct pumping in case of fire, furnishing a pressure of 80 pounds.

Distribution is by one mile of 6-in. cast-iron pipe, with 15 fire-hydrants, 3 gates and 25 taps. No meters are used. Service pipe is of wrought-iron. The daily consumption is 15,200 gallons.

The works have cost $13,000, which is the amount of the bonded debt at 6 per cent. The yearly expenses of maintenance are $850, and the receipts $700. The population in 1880 was 1,848, and is now said to be 2,800. The works are managed by a Board of Water Commissioners, of which F. S. Currie is clerk.

DCCLXXXIII.—WELLESVILLE, N. Y.

Wellesville, Alleghany County, N. Y., is in lat. 42° 5′ N., long. 78° N.

Water-works were built in 1883 by a private company, after plans of C. W. Knight, taking the supply from Crowners' Brook, which is fed by springs. The water is collected in a reservoir covering three acres, constructed in earth embankments, the inner slopes being rip-rapped, holding 7,000,000 gallons of water and being 185 feet above and 1¼ miles distant

from the village. A channel is cut along the side of the reservoir, into which the stream is turned in seasons of flood.

From the reservoir to the village the water is conducted by 10-inch cast-iron pipe.

Distribution is by 3½ miles of wrought and cast-iron pipe of 8 to 4 inches diameter, with 31 fire-hydrants and 180 taps. Service pipes are of wrought-iron and lead. No meters are used. The daily consumption is not known. The village pays $40 annually for the use of each hydrant. The works have cost $40,000. The bonded debt is $30,000 at 6 per cent. The yearly revenue from water rates is $3,000. The population in 1880 was 2,049.

W. S, Kuhn is Secretary and Treasurer, and Jno. McIntire, Superintendent.

WATER

COCHITUATE.

Of water called Cochituate,
A great cry has been made of late
In Boston, Massachusetts State;
And those who did investigate
The matter, do insinuate
That it is in a poisoned state,
And very sad may be the fate
Of those who try to satiate
Their thirst on what doth emanate
From tanks containing animate
Cochituate.

Arrangements seem inadequate
To fill the need importunate,
Of water fit to permeate,
To peregrinate and percolate
Through systems strong and delicate.

Why do we folks who pay our rate
Continue to prevaricate;
Let us demand from Legislat-
Ure, water ,' clane and pure and swate,"
And if they then equivocate,
Let's start a company some early date
The government to emulate,
And thus ourselves emancipate;
When something's done to ameliorate
Our State, we'll quickly relegate
To Sheol's gate
Cochituate.

'Tis thus the poet Laurie-ate
Does his opinions ventilate.

—*Boston Globe.* G. H.

HOLBROOK, Mass., is warmly engaged in the preliminary skirmishing looking to the introduction of a public water supply.

IN Milwaukee last week the consumption of water aggregated 108,569,124 gallons an average daily decrease of 350,181 gallons compared with the corresponding week of last year.

THE Owatonna, Minn., hose companies were called out September 22nd, to test the new pumps put in the city wells. A force of men forced water through 600 feet of hose to the top of the highest buildings.

THE contract for the Stoughton, Wis,, Water Works has been let to George C. Morgan, of Chicago. The competing bidders were the Holly Manufacturing company, of Lockport, N. Y.; E. P. Wheeler, of Beloit, and H. Pursell, of Chicago. Work will begin at once.

ABOUT 40 laborers, employed by contractors McKee & Lally, at Lockport, N. Y., struck for an increase of wages from 90 cents to $1.25 per day. The men have been engaged digging a trench for the pipes for the new waterworks.

THE new water commission held a long session at Albany, and considered the various projects proposed. No plan was definitely adopted, Mr. W. E. Worthen, of New York, who has been engaged as engineer of the new commission, was present and consulted with the commission in regard to certain surveys that are to be made and the work generally that is to be done.

EIGHTEEN miles west of old Fort Wingate, N. M., at the base of the Continental divide, there is a spring which has always been noted for its cold fluid. Recently some scientific researchers have run a tunnel in on the vein of water for a distance of fifty yards, resulting in striking a solid bed of ice. No wonder the Mexicans have given this spring the very appropriate name of Aqua Frisia.

JUDGE HOWELL has sustained the demurrer revived by the city of Adrian, Mich., to the suit of the waterworks company, to recover damages from the city for non-acceptance. The city claims inadequate water supply, and the company claims that mechanical adequacy alone binds the city to accept. The judge maintains that the declaration must allege sufficient water supply. It is not likely the company can sustain such an allegation.

AMERICUS, Ga., Easton, Pa., Troy, O., and Savannah, Ga., are moving for new water-works, or extension of existing supply.

THE break in the large main, which deprived over half of the citizens of Washington of the Potomac water supply for forty-eight hours has been repaired and water was again supplied September 25th.

GEORGE B. INMAN & Co., of New York, are building the Fort Madison, Ia., water-works, which are owned by the Fort Madison Water-works Co., the stock of which is chiefly owned by Inman Bros. There will be a Blake compound duplex condensing pumping engine, with a capacity of 1,500,000 gallons per day. Two reservoirs are constructed on a hill 226 feet high. The total cost will be about $125,000. W. L. Gamage, of Fort Madison, is superintendent.

IN mentioning the plant used on the Brown, Howard & Co., contract on the New Croton Aqueduct, in last week's issue, we omitted the all important item of pumps. We found about thirty of these engines distributed over this one contract, all of them from the A. S. Cameron Pump Works, of this city. The deep shafts, nearer Croton Lake, happen to be the wettest on the contract, and though the pumps are thus subjected to heavy duty their working is very satisfactory and economical.

THE South Side Improvement Company was incorporated at Albany September 25th, for the purpose of accumulating, storing and furnishing water for sprinkling and watering the roads in the towns of Babylon and Islip, Suffolk County, and for distributing such water and sprinkling and watering said roads. Capital stock, $5,000, consisting of 100 shares of $50 each. The corporators are H. A. V. Post, Henry B. Hyde, George C. Magoun, William P. Clyde, James F. Dunham, Samuel T. Peters and George F. Crane.

CAMPBELL & WOLF, to whom was awarded the contract for tunnelling through the ridge near the Dells dam for the Eau Claire, Wis., waterworks company, have thrown up the job as being unprofitable, and a new contract to complete the work has been let to James McIntyre, of St. Paul, the stipulation being $3 more per foot than was accepted by the former contractors. Over twenty miles of pipe have been laid by the Pittsburg Water Construction company, and the entire system will be ready for service about the 20th of November.

THE special committee to look into the question of obtaining pure water for all purposes for Big Rapids, Mich., have recommended an entire change of system—putting a large well above the city, and pumping by water-power instead of steam as at present. The Common Council voted unanimously to submit the matter to the taxpayers on the 14th of October, and have called an election for that date. The proposition will be to issue $35,000 in bonds at 5 per cent. The people quite generally favor pure water, but are divided as to the best plan of obtaining the same.

A CONTRACT has been awarded the Gloucester Iron Works by the Wilmington, Del., Water Commissioners, for the following supplies: 125 lengths of pipe, 2,000 pounds each, $27.50 per ton; 50 lengths, 600 pounds each, and 100 lengths, 390 each, $29; 100 lengths, 250 pounds each, $30; 20 inches special castings, 2½ cents per pound, and 8 inches special castings, 2¾ cents. The other bidders were the Meilert Foundry and Machine Company of Reading, R. D. Wood & Co., of Philadelphia, and A. H. McNeal of Burlington, N. J.

A WATER-WORKS is being constructed at Iroquois, Canada, by the Iroquois Water-works Co., whose shareholders belong to Montreal. A water power has been secured on the canal, and the company will supply the town with water for fire and household purposes. A large number of men are already engaged in building the flumes. Twenty-five hydrants will be put in this year, which will be increased as the different streets are piped. Mr. W. Perry, Jr., of Montreal, is the manager of the Company.

THE Jersey City *Journal* complains of the condition of the Passaic water during the past three or four weeks throughout that city. It says:

A reporter was informed that during the past three weeks a fleet of canal boats has lain at Belleville. It is said that the contractor who has to deliver the coal sublet the contract to another party, who failed to unload the boats. There are twelve or fourteen boats near the receiving main. All the slops and filth from the boats are thrown into the river at this point. This state of affairs is probably contributory to the impure state of the water at the present time.

THE committee appointed by the Pontiac, Mich., Common Council to examine different systems of water-works, have made an exhaustive report to the Council, setting forth at length the advantages and disadvantages of the different systems. They strongly recommend for Pontiac the adoption of the direct pressure system with a stand pipe; which is now being put in use at Lansing. They estimate the cost of constructing the works for Pontiac under this system at $75,000, which, they suggest, could be borrowed at four per cent. with twenty-year city bonds: and recommend that the city operate its own works. The committee have given this question careful attention and have visited the leading cities of the State for the purpose of getting reliable and practical information.

THE Pierre, Dak., waterworks have been bonded to Eastern capitalists for $70,000.

THE Locust Mount Water Company, organized by Philadelphians three years ago to supply Centralia and Mt. Carmel with water, has just paid $40,000 in damages to farms injured by the spreading of the company's pond, and two suits for $20,000 each are still pending.

PHILADELPHIA SEWERS.—It will require $268,000 to complete the intercepting sewer. In addition it was estimated that $50,000 will be required to construct the necessary storm water sewers in the valley at Dobson's Run and at Mifflin street, both at the Falls village.

THE engines for the Hillsdale, Mich., Water Works have been purchased. The pumping works are being erected at Bawbeese Lake, and will soon be completed. Pipe laying will be begun as soon as three miles of pipe are on the grounds.

THE Ocean Grove authorities, New Jersey, have about completed an artesian well in the head of Fletcher Lake. They estimate a flow of 50 gallons per minute, which will produce a rapid surface current, and improves the present condition of the lake as a source of water supply.

THE Shone sewage system has been tested at the Orphans' Asylum of Sacramento, Cal. The system has been in operation about a month, and is reported as working well, and there is some talk of extending it to the sewerage of Sacramento.

THE Albany, N. Y., water commission has been testing the Hyatt filtering system. In case the filter is adopted for use in that city, seven large filters would be built, each one capable of treating 3,000,000 gallons in 24 hours. The committee will make its report about the first part of this month.

HYDE PARK WATER-WORKS.—At a meeting of the Hyde Park Village, (Ill.) Board of Trustees held September 28th., to consider the proposals to furnish additional pumping machinery of 12,000,000 gallons daily capacity for the water-works, the report of the committee recommending the purchase of the Holly engines was placed on file, and the committee discharged by a unanimous vote. The matter now stands just where it did when the bids were opened. A new committee and another examination of the competing machinery will probably now be made.

GRAND ISLAND, NEB., will open proposals for waterworks on Monday, the 5th. Capacity to be 1,000,000 gallons per day. Amount not to exceed $34,000. Each proposal must be made separate on the following items, viz.:

1. Furnishing and building engine and boiler-house and base of tower.
2. Furnishing and building stand-pipe.
3. Furnishing and setting up machinery, boiler and connecting up wells.
4. Furnishing and laying cast-iron pipe mains, specials, hydrants, gates, etc. All bids for furnishing and laying pipe shall state separately amounts per ton for each of the different sizes of 4, 6, 8 and 10-inch pipe.
5. Furnishing and putting down wells.

FIXING THE LAND.—The dunes of Gascony, according to a recent report by the inspector of French public works, cover a surface of more than 200,000 acres, and are more than 250 feet high and three or four miles wide. The fine sand composing them was formerly pushed constantly inland by the wind, covering fields and villages, and even burying churches up to their towers. Since 1780 the difficult task of fixing the sand hills by creating a growth of vegetation on them has been in progress, and has at length resulted in averting a great public danger and forming a fine forest. The formation of new dunes is prevented by the building of a wooden palisade, against which the sea raises so steep a bank that no sand can be blown over the incline.

A COMMITTEE of the Boston Water Board has reported, under date of September 21st., on the impurities in the water supply of that city. In the Western Division, examined by Mr. Desmond Fitzgerald, C. E., the contemplated sewerage of Westboro may contain objectionable features; action is now pending regarding the Framingham sewerage into Beaver Dam brook; the Sherborn prison drainage fails of full success, and poliutes Course brook, and on Pagan brook, in Natick, difficulties are still met with and the work of purification must be pushed still further. J. H. Brown, of the Mystic Division, reports that many factories and individuals are practically draining into the water supply; the present sewer scheme is a half-way measure, is doing more work than originally intended and requires enlargement and change. The water supply has been copious, and is for the present and immediate future, secure from absolute pollution. Nearly all the towns on the water sheds of the Sudbury, Cochituate and Mystic are seriously contemplating local drainage; their early action may remove the most dangerous sources of pollution. As to future supply, the committee think that an early investigation of this subject will be wise.

THE water supply committee submitted two bids for furnishing Galveston with a fresh-water supply. One was from O. Chanute, G. W. Pearsons, non-residents, and J. M. Brown and A. M. Shannon, of Galveston. This bid proposed to furnish a water supply from a rainfall source somewhere on the mainland near Virginia Point. They would provide a grass-covered surface meadow basin, from which cattle would be excluded. This basin would be supplied by the necessary drain-pipes. The city would be supplied by an iron pipe running under the bay to a pumping system located on the island west of the city. The water would be filtered if found necessary. The pumps would be of sufficient capacity to supply 3,000,000 gallons of water in excess of the average demand per day. The system would, on a test, be guaranteed to send water through a hose attached to a hydrant in the city, a vertical distance of 100 or a corresponding horizontal distance of 131 feet. Three hundred hydrants would be provided at $150 per hydrant, or $100 each for additional hydrants. All hydrants to be kept in repair, the city to be furnished certain water for public purposes, and the work to be completed within twenty-four months from date of contract; contract to be awarded within ten days from opening of bid.

The other bid was from G. Norman Weaver, treasurer of the New England Construction Company, and agreed to furnish water from Sweet lake or any other available source, by what is known as the direct system, giving a force equal to that attained from a 200-foot stand-pipe located in the city. Work to be completed by January, 1887. Three hundred hydrants at $90 per hydrant and $80 each for additional hydrants.

These bids were referred to the joint committee on water supply, and citizens for examination and report as to the best bid.—*Galveston News*, Sept. 24th.

NEWS OF THE WEEK.

Contracting.

New York City.—The Public Works Dept. will receive bids until October 13th., for a foot bridge, retaining walls, and grading 4th. avenue at 98th. street.

New Bridge.—The contract for building the substructure of the new iron bridge across the Kinnickinnic river at Milwaukee has been let to C. H. Starke, of Milwaukee, for $26,500.

Allegheny City Contracts.—At a meeting of the Allegheny City Committee of Streets and Sewers, the following contracts were awarded: To L. Sloan for sewer on East Ohio street, at $380: to John M. Orr, for sewer on Balph and McBrier alleys, at $446: to Thomas Carson, for grading and paving Nixon street, at $670. The bonds of Messrs. Sloan, Carson and Orr, were presented and approved.

Winona Bridge.—At a meeting of the Winona, Minn., city council the ferry committee recommended the reconstruction of the south portion of the long bridge on the ferry road opposite the city, and the committee was authorized to have plans prepared. It will probably be a truss bridge. There were ten proposals for building the bridge across Lake Winona at the Huff school crossing, ranging from $9,750, to $13,000. John Stelwagen, of Winona, got the contract at $9,750 for the bridge and approaches. It is to be completed by the 15th of April. The sanitary inspector reported in favor of adopting the Durham system of sewerage.

The Shroeppel Bridge, New York—Proposals for a wrought-iron truss bridge over the Oneida river at Shroeppel's landing, between the counties of Onandago and Oswego, were opened September 25, at Congress Hall, Syracuse by the Supervisors committee. The Croton Bridge company's lowest bid, high truss, was $2,490 and low truss, $2,525; the King Bridge company of Cleveland, O., bid for a high truss $2,740, and low truss $2,998; Berlin Bridge company of Connecticut, Pratt high truss, $2,479.75; S. Twiss, of Cortland, $3,100; Penn Bridge company of Beaver Falls, Pa., $3,227; Howard Soule, of Syracuse, $2,552; G. W. White, of Syracuse, $2,875.

Lincoln Park Breakwater.—The Lincoln Park Commissioners of Chicago, Ill., have accepted plans for a breakwater protection to the Lake Shore drive. The improvement will be about 1¼ miles long and from 300 to 800 feet from the present shore; the space between is to be filled up and 100 acres added to the Park. The breakwater will be built of piles in two rows, 10 feet apart with piles spaced 5 feet, and sheet piled with oak and that filled with "bark." The rows of piles will be tied with iron rods and braced with plank. The piles will be sawed off at the lake level, and the top of the breakwater covered with a 12-inch stone paving. Sand will be pumped from the outside behind the protection and the ground gradually raised 5 feet above the lake level. This new addition to the Park will be paved with stone, and is expected to furnish an indestructible artificial beach. The total cost is estimated at $500,000 and five years will be required to complete it. This fall about 2,000 feet of it, will be let by contract, amounting to about $35,000.

Dry Dock.—The Halifax N. S. City Council has accepted the offer of the Halifax Graving Dock Company to construct a dry dock on the guarantee of a subsidy of $10,000 per annum for twenty years by the city, the British Admiralty having already agreed to pay that sum, and the Dominion Government being expected to do the same. The dock is to be a granite face one of not less than 580 feet in length, 100 feet in width at least, and 30 feet draft of water over the sill at the entrance.

Bids for Reservoir.—The following are the totals of bids for building the Fisher Hill Reservoir at Boston, which were opened September 29th:

Trumbull & Cheney, Lawrence and Chelsea,	$ 74,130.90
Moulton & O'Mahoney, Lawrence	75,606.30
Patrick Grace, Brighton	87,727.64
Charles Linehan, Cambridge	88,491.50
T. F. & J. J. Maney, Boston	89,523.05
O'Connor, Webb & Batchelder, Boston and Worcester	93,619.00
J. H. Leavitt, Boston	99,772.35
R. A. Malone, Lancaster, Pa	103,623.50
W. H. Ward, Lowell	111,726.00
Parker & Sylvester, Boston	117,092.00
Wilcutt & Perkins, Boston	118,876.00
Boynton Bros., Boston	131,840.30
G. W. Hendrick, Easthampton	143,201.00
Hugh Nawn, Boston	217,790.00

NOTE.—Next week we will publish full details of these bids, which came to hand too late to be inserted in this number.

The Viaduct at Omaha, Neb.—At a consultation held September 21, in reference to the proposed viaducts, the one specially discussed was that on Eleventh street. City Engineer Rosewater, Chief Engineer Smead, of the Union Pacific, Messrs. Calvert and Weeks, of the Burlington & Missouri, and Councilman Goodman were present. It was agreed that the roadway should be twenty feet in width, with sidewalks six feet wide with a railing on the outside. The walk is to be 8 inches above the roadway and separated by curbing. The roadway is to be paved with wooden blocks. The approaches at each end will be of masonry, with stairways leading to the top of the bridge. The viaduct is to extend from Jackson street to the alley south of Marcy street, and will range in height from twenty to thirty-seven feet above the ground. Above the tracks there will be twenty feet of clear space. The width of the roadway will be sufficient to allow the laying of a double steel car track, giving plenty of room for teams to pass. The estimate for construction of this viaduct was placed at $75,000, but it is thought that the entire expense, according to the plans now contemplated, will be inside of $60,000. The viaduct will be about 1,300 feet —a quarter of a mile—in length.

Mining Debris.—There is great alarm in California about the movement of mining debris in the rivers. The *Call* says:

There is not a day's time to be lost in preparing to ward off the impending calamity. The overflow of debris has ceased to be a question of dollars and cents, and become one of the preservation of life and the means to live. Property to the amount of not less than $50,000,000 is threatened, involving not merely pecuniary loss, but thousands of beautiful and happy homes. There is no other question before the public at present so urgent in its nature, so vast in its consequences and so difficult of solution. How shall we dispose of the debris now moving down upon us from the mountains so as to preserve both the chain of bays through which the river flows to the ocean and the valley of the Sacramento, with its cities and villages and its country homes?

To this the Sacramento *Union* adds: "We repeat the exclamation there is not a day's time to be lost. But we amend our contemporary's figures by $100,000,000.

Hudson River Improvements.—The bids for removing 37,000 cubic yards of material from the river between the railroad bridge and the Troy dam were as follows:—

	Per cubic yard.
E. M. Payn, Albany	22 8-9
E. R. Seward, Albany	12¾
J. M. Seward, Albany	20
John McDermott, Cohoes	13¾
M. R. Pidgeon, New York	14 3-5

The contract was awarded to Mr. E. R. Seward.

BIDS FOR MAKING DYKES.

For building 1,000 feet of new dyke opposite New Baltimore, extending southerly from the end of the State dyke, the following bids were received:—

	Amount.
Leonard Marshall, New Baltimore	$8,372.78
Isaac Thomas, Fultonville	8,954.80
G. V. Rapp, Canajoharie	8,511.60
Wm. Fuller & Sons, Albany	7,909.97
M. R. Pidgeon, New York	8,519.09
John B. Marshall, New Baltimore	8,886.50

For repairing Castleton dyke, proposals were made:—

	Amount.
Isaac Thomas, Fultonville	$675.92
John B. Marshall, New Baltimore	139.14
Leonard J. Marshall, New Baltimore	169.44
Wm. Fuller & Sons, Albany	123.98

Both contracts were awarded to Wm. Fuller & Sons.

Dredging.—During the month of August the Okeechobee, Fla., Company's dredge No. 3 cut 2,785 feet of canal, 8 feet deep and 80 feet wide, an average of about 1,600 cubic yards per day. During the same time dredge No. 2, after losing eleven days in repairs, cut 1,050 lineal feet of canal, 6 feet deep and 30 feet wide, making the excavations of the two dredges during August amount to 51,600 cubic yards.

Railroads, Bridges and Canals.

Venezuela has contracted for the building of three railroads from the capital into the interior.

The Fonda, Johnstown and Gloversville Railroad, N. Y. is making extensive repairs to the roadbed.

C. B. & N. R. R.—Work at pile-driving and grading has been commenced at La Crosse, Wis., on the Chicago Burlington and Northern line.

Old Colony R. R.—The Engineers of the Old Colony Railroad have begun a survey of a line from South Framingham to Wattapan.

St. Paul to Kansas City.—Three surveying parties are reported to be in the field for the survey of the new Kansas City line of the St. Paul road.

Railroad Opened.—A railroad has been built and opened to business between Los Angelos and Pasedena, Cal., through the heart of the orange orchards.

The Ellsworth Extension of the Omaha from River Falls to Ellsworth, is nearing completion. The track is being laid with great rapidity, and will be all down next week.

Florida R .R.—The survey of the new railroad from Lake Park to Kissimmee, Fla., is nearly completed, and the work of grading will be commenced at an early date.

The Texas & St Louis Narrow Gauge Railroad is to be made a standard gauge railroad as soon as possible. The work of widening the roadbed has been begun at Malden, Mo.

The Lake Erie & Western, although in the hands of a receiver, is making extensive improvements on its road. About 3,000 tons of steel rails will be laid within the next two months.

Railroad Puzzler—Here is a problem that would knock out the sphinx, I verily believe: Suppose two trains met on a single track, each thirty cars in length. A siding is there that can hold only fifeen cars. How are these trains going to pass each other? SWITCH.
—*Boston Globe.*

Detroit, Bay City & Alpena R. R.—About 100 laborers have been hired by Alger, Smith & Co. to work on the extension of the Detroit, Bay City & Alpena Road, Michigan, from Au Sable to Black River, a distance of nearly thirty miles. The men receive seventy-five cents per day and board, the average wages paid in the northern woods.

Building for Timber.—A Pennsylvania company has in view the construction of a narrow gauge railroad from Caldwell to the timber country of Idaho. Men will soon be sent out to select the route. It is probable the road will run up More creek, as this would be the best way to reach the largest and best belt of timber in Idaho.

The Union Bridge Company have their hands full of orders, and are working to their fullest capacity. They are engaged in building the Kentucky and Indiana bridge across the Ohio at Louisville, and expect to finish it by Jan. 1st. They also have the contract for the foundations, masonry and superstructure of two bridges for the St. Louis and San Francisco road. One of these, spanning the Arkansas river at Van Buren consists of four spans of 165 feet each, three spans of 250 feet each and a draw of 360 feet. The other, the Tulso bridge, crossing the Arkansas river in the Indian Territory, will consist of 9 spans of 155 feet each. These bridges will be finished by January.

Three bridges are being built for the Chicago, Burlington and Northern Railroad, the bridge company having the contract for the foundations, masonry and superstructure. The one over the Chippewa river will consist of seven spans of 140 feet each, and one draw of 320 feet. The Wisconsin river bridge for the same road will consist of six spans of 180 feet each, four spans of 120 feet each and a draw 240 feet. The St. Croix river bridge will consist of a draw of 360 feet and one span of 153 feet. Considerable work is also being done by them for the Maine Central road, the most important of which is a bridge, consisting of four spans of 175 feet each over the Kennebec river at Augusta, Me. Besides this they are doing a large amount of other miscellaneous work, consisting of bridges of one, two and three spans.

For the Pittsburg, Cincinnati & St. Louis road they are building two bridges, one of them over the Wabash river having five spans of 150 feet each, the other over the Muskingum river, having four spans of 150 feet each. They have orders from the Buffalo, New York & Philadelphia; Chicago, Milwaukee & St. Paul; Illinois Central; Denver and Rio Grande; New York Central; Delaware & Hudson Canal Company, and the Indianapolis Decatur & Springfield.

R. R. Purchased.—The Chicago & St. Louis Railway Company has purchased the Chicago, Pekin & Southwestern Railway.

New York Central Extension—The N. Y. Central company has commenced work on the extension at East Lockport.

Saratoga and Almaden Railroad.—Grading has been commenced on the Saratoga and Almaden Railroad—which is to connect the Southern Pacific at Mountain View with the New Almaden Mines in Santa Clara County, California. It will be about 22 miles in length. Standard gauge. Henry A. Brainard of San Jose, California, is Chief Engineer.

A New Bridge at Omaha.—The Union Pacific Company has made formal announcement of its intention to commence at once the construction of a double railway track, wagon, pedestrian, and general thoroughfare bridge to take the place of the present structure between Omaha and Council Bluffs. The piers are to be of solid masonry, and the work pushed from the present until its completion, probably before the end of 1886.

New R. R. to Denver.—A company has recently been organized to build a road from Baxter's Springs, Kan., to Denver, Colorado, with a view of making an ultimate junction with the Pacific & Great Eastern road at Lafayettville, Ark., and the contract for building the first sixty miles has already been let.

The Carbondale and Paducah Road.—The Carbondale, Metropolis and Paducah Railroad Company, of which Dr. J. H. McLean, of St. Louis, is the financial agent, is booming in Johnson County, Ill., at present. The work of locating and grading is under the supervision of Messrs. Chase and Dishman, who have their camps located about ten miles southeast of Vienna. They have six miles already graded, and the work goes briskly on.

The Minneapolis, Sault Ste. Marie & Atlantic.—Work upon the Minneapolis, Sault Ste. Marie & Atlantic is progressing rapidly. Track-layers are now at Deer Tail, and the road is practically graded to what is known as "End of Track," a point seventy miles east of Turtle Lake, 135 from St. Paul, and 145 from Minneapolis.

New Mississippi Bridge.—The project of a new bridge over the Mississippi river has been formally brought before the Merchant's Exchange, of St. Louis, and is recommended as an escape from the existing bridge arbitrary and other evils. It is said that the New York Central and Pennsylvania people are quite anxious that the improvement should be made, believing that it would be of advantage to their interests in this direction.

A Colossal Passenger Station.—Every portion of the civilized world must now acknowledge that the station of the London & Southwestern railway (called "Waterloo station") is the colossus of stations. It was to-day declared complete, having for a long time been at one end, under the hands of masons and carpenters. Imagine twenty-five acres roofed in, and the building covering this area containing fifteen platforms and nineteen distinct lines of rails, making an aggregate length of four miles. Imagine, also, a signal-box containing 180 levers. During the building, extending over very many years, of this enormous station, 800 houses have been demolished and a population of 3,000 displaced. The cost, however, from the first opening to yesterday, has been only a million and three-quarters dollars. It is over this railway, with its thirty spur lines, the traveler reaches England's southern and southwestern counties, containing Portsmouth, Southampton, Isle of Wight, etc., and by railway steamers Havre and the Channel islands. There is no minute through the day during which some train does not depart or arrive at this station.—*London Letter.*

Canada, La Crosse & Southwestern.—A party of gentlemen locating the line for the proposed Canada, La Crosse & Southwestern railway is now in the upper peninsula, and has nearly reached the line of the Chicago & Northwestern about ten miles below Negaunee, Mich. C. M. Ferguson, Chief engineer, and J. G. Shradley, right-of-way agent, with several assistants, comprise the party. The line has been run from La Crosse to here, and will be taken on to Sault Ste. Marie. It will cross the Chicago & Northwestern and run a number of miles to the south of the Marquette, Houghton and Ontonagon line, unless the route now being laid out should be changed. The party will not reach Sault until nearly the middle of October, and it is not likely that any construction work will be done this winter. The proposed route of the new road is from Sault Ste. Marie, Canada, opposite the American Sault, to Rhinelander, on the line of the Milwaukee, Lake Shore & Western, from there to La Crosse, on to Charles City, Iowa, and from there to a point in Northern Missouri. The projected plan of the road is a novel one, cutting, as it does, diagonally across the main trunk lines of the Northwest. The projectors of the road are enthusiastic over the prospect, and think that it will yet become a powerful factor in railroad transportation rates.

Short Route to New Orleans.—The Louisville, New Orleans and Texas Railroad engineer corps is now surveying a branch road from Lula, Miss., to Glendale, Miss., opposite Helena, Ark., and will immediately, it is said, build the road and place a transfer boat at that place.

The Northwestern's Extensions.—The engineers of the Chicago & Northwestern Railway have begun surveying a line from Yankton, Dak., through Bon Homme County. The force is a large one, and the work is being pushed ahead rapidly. It is surmised that the company will immediately begin grading on this line.

Cincinnati, Georgetown and Portsmouth R. R.—This road reorganized at Cincinnati, September 22nd, under its new owners as follows: Directors—Col. Orland Smith and Messrs. Alex. McDonald, Henry Roelker, Ralph Peters and M. E. Ingalls. President: M. E. Ingalls; Vice President, Ralph Peters; Secretary and Treasurer, Henry Roelker. The road will be completed to Georgetown, O.

Georgia R. R. Incorporated.—Articles of incorporation of the East Georgia and Florida railroad company have been filed with the Secretary of State of Florida for the building of a railroad from Hart's Road (Transit railroad) to Jesup. The line has been surveyed by Mr. Bushnell from Hart's Road to St. Mary's River, where a bridge for crossing was also designated. Mr. Morse, general manager of the road, states that work will be commenced on the road by October 1st.

City R. R.—The Mount Auburn, O., Board of Public Works at its meeting September 24th, granted the Cincinnati Inclined Plane Company permission to construct and operate a cable (electric or compressed air) railroad over the present route of the Main street line of horse cars. This includes, of course, the Lookout House of inclined plane and the hill cars to the Zoological Garden, which means better transit to the Zoo; something badly needed. Messrs. G. A. Smith and Joseph A. Hill are the incorporators of the company.

The Wisconsin Central Extension is getting along very well. The right of way is secured all the way through, with the exception of less than twenty-five miles and condemnation proceedings are in progress for its acquisition. The wet weather of the past few weeks has been somewhat of a hindrance, and has kept a number of farmers who live along the line from putting their teams to work on the grading. There is still a demand for teams, at from $3.50 to $3.75 per day, and there is work for at least 200 more teams than there are at present employed.

The Atlantic & Pacific's new iron bridge on the Central Division, which is taking the place of a trestle at Tulsa, I. T., will be completed about November 1st. The structure will cost a little over $100,000. The Central Division now extends only about four miles beyond the Arkansas River, but, as the public has already been informed, it is the intention to build within a year about 100 miles further towards the panhandle of Texas. The location and all rights were secured long ago. It is estimated that at present prices the road can be built and equipped for about $15,000 a mile.

Honduras Central R. R.—Among the new American enterprises for the development of the trade and commerce of Central Honduras is the proposed Honduras Central Railway, running from the port of Truxillo, on the Caribbean Sea, to the Bay of Fonseca, on the Pacific coast. The proposed road, upon which work will be commenced about Jan. 1st next, will be the shortest trans-continental line north of Panama, and will be from New York 1,300 miles nearer San Francisco than the Panama route.

Tunnel and Mining Plant.—The Bucyrus Foundry & Manufacturing Co., of Bucyrus, O., are now calling especial attention to their mining and contracting plan, including mine locomotives and cars, mining machines, steam shovels, tunnel machines, steam dredges, etc. Their mine cars, with self-oiling, chilled wheels, are a special feature in this plant; these wheels are made of Coldblast Lake Superior Charcoal Iron Cast in chills; the hub and axle are both long, insuring greater service and easier running and the self-oiling arrangement has been tested by actual use. Upwards of 1500 cars made by this firm and equipped with their wheels are in use, and are commended as neat and durable.

New York & Council Bluffs R. R.—Articles of incorporation and consolidation have been filed for the New York and Council Bluffs railway company, it being a consolidation of the several companies organized under a similar name in Ohio, Indiana, Illinois and Iowa, and intending to have a line running from the eastern boundary of Ohio to Omaha. The new line is still largely on paper, but the prediction is made that in time it will be on the ground. The officers of the company in its consolidated form are: Isaac B. Hymer, of New York, president; James F. Dane of Chicago, vice president; Lindley M. Ninde, of Fort Wayne, treasurer. Among the directors is Congressman Joseph Lyman, who was the secretary of the New York and Council Bluffs railway, of Iowa. The capital stock of the company is placed at $21,150,000.

The Chicago Burlington, & Quincy has commenced the construction of an ice bridge at Nebraska City to facilitate transportation across the river from Iowa during the winter.

Work of Locomotives.—To perform the work of the locomotives of the single State of Massachusetts, it would require a population of 9,000,000, in place of 1,750,000, and the 400,000 horses in place of 100,000; and these 9,000,000 of people and 400,000 horses would be obliged to subsist on the present means of subsistence. One can easily imagine the results.

Illinois Central.—James C. Clarke, president of the Illinois Central Railroad, was in Memphis last week for the purpose of making the necessary arrangements for the continuation of the business connections, which have prevailed for a number of years between his road and the Mississippi and Tennessee, which connects with his line at Grenada, Miss. The building the branch road, from Yazoo City to the Yalobusha river, is being pushed rapidly and will soon be completed.

The Storm King Project.—Chauncey Vibbard and General Manager Swan of the Storm King Bridge project had a conference at Boston, September 25th, with some leading cotton manufacturers relative to the building of the link uniting the Eastern system of roads with the coal and cotton fields. The manufacturing interests urged that work be begun at an early day, and promised aid to the undertaking. Messrs. Vibbard and Swan pledged that the manufacturing interests of the East should have representatives in the Board of Management, and said that work would be begun this fall.

Railroads in the Mountains.—It is stated that a strong force with improved implements are at work on the Carolina Railroad extension from Shelby to Forrest City, N. C., with an engineer corps in the field between the latter point and Rutherfordton. Between the two last named places, the Massachusetts and Southern Construction Company will begin railroad building next week, according to current rumor. The expenditure by this company at $20,000 in railroad surveys will either build a monument to incredible stupidity, or it will build a railroad.—*News and Courier.*

Nebraska to Texas.—Chief Engineer G. B. Finney and a corps of surveyors arrived at Red Cloud, Neb., September 24th, having completed a line from Dodge City, Kan., for the new Chicago, Nebraska, Kansas and Southwestern Railroad. Engineer Finney reports great enthusiasm along the line, and says the building of the road is now positively assured. The new road will be the first direct feeder from Nebraska to Texas, and, with its connections, will make an almost bee line route from the Gulf to the lumber regions of the North.

New Pennsylvania Corporations.—Charters have been issued at the State Department of Pennsylvania, as follows: The Allegheny and Perrysville Passenger Railway Company of Pittsburg, with a capital of $15,000. Wilkesbarre and Harvey's Lake Railroad Company, capital stock $150,000. The principal offices of this line which will not exceed fifteen miles in length, will be at Wilkesbarre. The president and directors are as follows: J. J. Shonk, president; Albert S. Orr, Theodore F. Ryman, Ira E. Hartwell, Wilkesbarre; G. W. Shonk and Josiah W. Eno, Plymouth; L. M. Wilson Scranton.

The Severn Tunnel.—The passage through this tunnel of the first train of passengers on September 5, last, marks the successful completion of this immense undertaking, in which 75,000,000 bricks have been used, and about 700,000 yards of excavation, principally through rock has been accomplished. The whole of the tunnel under the river is quite dry, but on the Monmouth side, where the big spring was met with, there is still a slight leakage. The train which contained the directors and officials took about twenty minutes in passing through the tunnel, which will be ventilated by a Guibal fan capable of discharging 240,000 feet of air a minute. One result of this great work is the shortening of the distance between Cardiff and London by thirteen miles.

The Adirondack Railway.—This road is in operation for a distance of about sixty miles from Saratoga (the terminus of the Boston, Hoosac Tunnel and Western Railway), and it is proposed to construct it to Ogdensburg, on the St. Lawrence river, a distance of about 185 miles from Saratoga, with a branch from Canton to Waddington, where a bridge will be built across the river, under charters already obtained from both the United States and Dominion Governments. At Ogdensburg the road will connect with the waters of the St. Lawrence at the foot of Lake Ontario, and also by ferry (open the year round) with the Canadian system of roads at Prescott, giving a line from Boston to Chicago, via the Hoosac Tunnel, of 1116 miles in length, while the bridge at Waddington will bring it into connection with the Canadian Pacific Railway. The distance between Ogdensburg and Boston, via the Tunnel, will be but 390 miles, which is much less than by any existing route, while the distance from the former point to New York City is also reduced materially.—*Boston Journal*

Westport (Conn.) Bridge.—The piers of the new bridge at Westport, Conn., are nearly completed and the bridge will soon be put in place.

They Mowed the Towpath for Dividends.—NEW HAVEN, Sept. 20.—The death of an old Cheshire farmer who was a stockholder in the famous Farmington Canal, over the towpath of which the New Haven and Northampton Railroad now runs, has revived a local old-time joke. Mr. Munson, for that was his name, had waited for several years for a dividend on his canal stock. At length, seeing that there was no prospect of getting anything, he went to the President of the company and complained. The latter told him that there was no dividend and no prospect of one, and that if he wanted to get a dividend that summer there was no other way for him to get one than to go home and get his scythe and mow the towpath. Mr. Munson did so. He mowed about eight miles of path, and cut off enough hay to net himself about 20 per cent. on his stock. After that the stockholder used to mow the towpath for dividends every year as long as the canal was in existence.

The Trans-Andean Railway.—The Canadian Transcontinental Railway will be opened for freight and passenger traffic to British Columbia next month. There will then be four transcontinental railways in North America—the Canadian, the Northern Pacific, the Union Pacific and the Southern Pacific. Considerable progress has been made within a few years, however, in the construction of another transcontinental road that now almost spans South America. The expansion of the Argentine Republic's system of railways and the remarkable development of that country's natural resources indicate that intelligence, industry, and energy are again to be powerfully exhibited in the temperate zone. The first section of the South American Transcontinental Road extends from Rosario, on the River Parana, westward to Villa Maria, and is 120 miles long. Another section of eighty-two miles was built by the Government in 1873, and in 1875, the line was extended 76 miles to Villa Mercedes. In 1880 the Government completed fifty-nine miles more, taking the road to the City of San Luis. Two years later the rails were laid to La Paz, seventy-five miles, and in April last the completion of the line to Mendoza, eighty miles further was celebrated by a grand festival. From that point a branch 100 miles long has been constructed northward to the City of San Juan.

On the other side of the Andes the Chillians are using a railway 100 miles long, extending from Valpariso to Los Andes. The gap between the Pacific and Atlantic sections of this trans-Andean road is only 140 miles in length. The route has been surveyed through the Uspallata Pass, and it is believed the missing link will be supplied within two years. The Argentine Republic has 2,800 miles of completed road, with nearly 900 miles more under construction, and 2,000 or 3,000 miles projected. The wild Indians that, until recently, held the plains to the northward, have been subdued, and colonists are taking their lands. The partition of Patagonia was followed by the complete overthrow and subjection of the fierce savages who had roamed over the Patagonian prairies. Ranch-men now occupy the southern pampas. There are said to be 100,000,000 sheep grazing on the lands of the Republic. When the projected railways shall have been built the country's surplus cattle, wool, and wheat will give it great power in the world's markets.—New York *Times*.

Index to Periodical Literature.

Electric Lighting.—*On Private Installations of Electric Lighting.*—Paper read before the Inst. Mech. Engs, by R. H. C. Nevile. Considers the question of the use of the electric light in houses. Describes the wiring and lighting of a house with 125 lamps, and the generating plant. Richardson's electric governor used. The results have been satisfactory. *Engineering*, August 21, 1885, pp. 189, 190.

Public Works.—*Public Works of the Orange Free State S. Africa.*—Gustave Hallé, A. M. I. C. E. The state is an undulating table land of 70,000 square miles, with a total population of about 134,000; average annual rainfall 20 to 25 inches. Telegraph lines constructed by native labor, total cost $600 per mile. Two stone and three steel bridges, the largest has four spans of 120 feet; parabolic bow-string girders, pin connected. Surveys made for railways on which bowl sleepers will be used, being far cheaper than wooden. Irrigation works projected. *Min. Proc. Inst. C. E.*, session 1884-85, vol. lxxxi, part 3.

Rivers.—*Three Problems in River Physics.*—The problems are: 1. Transportation of sediment, and formation and removal of sand bars: 2. Flow of water in natural channels: 3. Relation of levees to great floods, and to low water navigation of rivers. The sediments carried in suspension and by rolling on the bottom are dealt with; formulæ given for the flow of water: and the advantages of levees near to or far from the river banks compared. Prof. J. B. Johnson. Reproduced from Proc. Am. Assoc. for Science. *Van Nostrand's Engineering Magazine*, September, 1885, pp. 222 to 227.

Rolling Stock.—*Norwegian Sleeping Car.*—Combines the leading features of English and American construction: it is divided into compartments, has a central passage, and is carried on two four wheeled trucks. Illustrated. *National Car Builder*. September, 1885, p. p. 118, 119.

Sleeping Car.—Of English design and construction, for the Buenos Ayres Great Southern Railway, only six sections and a stateroom. Length over platforms 34 feet 1 inch; width over sole bars 7 feet 7 inches. Body 29 feet long, 10 feet wide; height at center 8 feet 8¾ inches. Wheels 42 inches diameter, wheel base 18 feet 10 inches. Illustrated. *Railroad Gazette*. August, 28, 1885, p. p. 547, 548.

Strains.—*Graphic Determination of Bending Moments in Structures with Varying Loads.*—A paper by M. Collignon. Describes the theory of strains, the polygon of forces, and the method of obtaining diagrams of strains under various conditions of loading. The subject is dealt with fully by the aid of formulæ and several diagrams. *Annales des Ponts et Chaussées*. July, 1885, p. p. 5 to 46.

Train Speed.—Details of the recent fast run on the N. Y. W. S. & B. R. R.: includes a set of tables of the speed between stations on each section, and of the physical characteristics of the road, and a summarized speed record. A diagram is given from the schedule board, and figured outline drawings given of the two classes of locomotives which hauled the train. Highest speed 84 miles per hour. *Railroad Gazette*. August, 28, 1885. p. p. 548, 549.

Water.—*Purification of Water by Iron on a Large Scale.*—At the Antwerp Water Works, the Bischof system of filtering through spongy iron and gravel was adopted, but later a method was introduced, rendering gravel unnecessary, and expediting the process. An iron cylinder revolving on horizontal hollow trunnions, and fitted with ledges to agitate the contents is charged with iron borings, etc., and the water passed through by the trunnions, the result being eminently satisfactory. The chemical aspect of the process is also dealt with. Illustrated. W. Anderson and G. H. Ogston. *Min. Proc. Inst. C. E.* Session 1884-85, vol. lxxxi., part 3.

Water Supply.—*The Waters of London and Amsterdam.*—Describes the difficulties of supplying London as far back as 1560, and shows the rapid increase of area to be supplied to the present time. The methods of utilizing the supply, its treatment and distribution by the different companies, the average consumption, and other matters are dealt with. Amsterdam having no river of potable water, obtains rain water supply by draining the sand hills at Haarlem, pumps and stand-pipes being employed to give the necessary pressure. Plans, profiles and tables are given. *Annales des Ponts et Chaussées*. July. 1885, pp., 154 to 219.

Windmills.—*Report on a Competitive Trial of Windmills.*—Five machines entered for the tests, which included the speed and quantity of water pumped under a certain pressure in light and heavy winds. Speed indicators were used for the former, and the Keystone water meter for the latter. The trials are described, and a full description given of the meter. Illustrated. *Reports to the Pennsylvania State Agricultural Soc.* December, 1884, January, 1885.

Market Report of Engineering Materials.

New York, October 1, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles		1.9c.	@ 2.2c.
Tee		2.2	@ 2.4c.
Beams and channels American		3.0c.	@
Tank		2.	@ 2.1c
Shell		2.4c.	@ 2.5c
Steel plates, Tank		2¼c.	@ 3c.
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black	Discount	42½	@ 45
" " galvanized	"	35	
Lap welded black	"	60	@ 62½
" " Galvanized	"	45	
Boiler tubes	"	57½	
RAILS.			
Steel (large lots at mill)		29.00	@ 30.00
Old rails		17.25	@ 17.50
Old rail steel		17.00	@ 18.00
R R. spikes		1.8	@ 1.9
R R. splice-plates		1.65	@ 1.7.
R R Track Bolts Square Nuts		2.55	@ 2.65
Barb-wire fencing, galvanized			4.50
" " painted			3.50
Corrugated iron			
Nails			
Iron		2.50	
Steel		2.75	

METALS.

COPPER.		
Lake Superior	11	@ 11½
Other Brands	10¾	@ 11¼
LEAD.		
Com. Domestic	4.25	
Lead Pipe	.06¾	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.06¾	
ZINC.		
Sheet	5.65	@ 5.87

BRICK.

(Cargoes afloat)		
Haverstraw per M.	$5.75	@ 6.00
Fishkill		
Up-River	5.25	@ 6.75
Jerseys	4.62	@ 5.50
Long Island		
" pale	2.75	@ 3.00
FRONTS.		
Croton red	11.00	@ 14.00
" dark	11.00	@ 14.00
" brown	10.00	@ 13.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	65.00	@ 130.00
" American	85,00	@ 120.00
Fire brick	25.00	@ 40.00

CEMENT.

PORTLAND.		
Gibb's English 400 lbs, per bbl	2.75	@ 2.90
K. B. & S. " "	2.85	@ 3.00
J. B. White & Bros., Portland Cement	2.65	@ 3.00
do Keene's Superfine,	8.00	@ 10.00
do " Coarse,	5.00	@ 6.00
Roman	2.75	@ 3.50
Largerdorfer German "	2.55	@ 2 80
Dyckerhoff, " "	2.90	@ 3.25
Stettiner " "	2.60	@ 2.65
Hanover "	2.60	@ 2.65
Vorwohler, Lion "	2.90	@ 3.25
Alsen, " "	2.55	@ 2.60
Fievé "	2.40	@ 2.50
Saylor's American	2.15	@ 2.40
Windsor, Standard, U. S. C. Co.	1.00	@ 1.10
Cable's Portland, F. O. Norton	2.15	@ 1.15 2.40
ROSENDALE cements	90	@ 1.00

LIME.

Rockland common per bbl	1.00	
" finishing	1.20	
State, common	.90	
" finishing	1.10	
Kingston, ground	0.95	
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@ 95
" " No. 2 "	0.75	@ 0.80
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " "	0.75	@ 1.00
Brownstone, Portland, Ct. "	1.00	@ 1.30
" Belleville, N. J. "	0.75	@ 1.25
Granite, rough	0.60	@ 1.25
Common building stone per load	2.00	@ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00

SLATE.

Purple roofing per square	6.00	@ 7.00
Green "	6.00	@ 7.00
Red "	15.00	
Black Penna. (at New York) "	4.50	@ 5.00

LUMBER.

Prices for yard delivery in New York

PINE, Common box per M.	18.00	@ 20.0
" Choice "	55.00	@ 80.
Tally plank, 1¼ in. 10 in. dres'd, each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	20.00	@ 22.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2½ × 4 to 4 × 6, in	.17	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30,00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" " sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate "	2.10	@ 2.25

PAINT.

Lead, white, American dry per lb	.04¾	@ .05
" " " in oil pure "	.05½	@ .05¾
English, B. B. in oil	.08½	@ .08¾
Red, American	.05½	@ .05¾
Litharge "	.05	@ .05¼
Venetian red, American "	.01	@ .01¾
Indian red "	.05	@ .10
Vermillion, American lead "	.11	@ .11¾
Paris green "	.15	@ .19
Umber, Amer. raw and powdered per lb.	.01¾	@ .01¼
Drop black, Amer.	.08	@ .12
" " "	.09	@ .11¾
Chrome green	.05	@ .15
Oxide zinc, American	.03¼	@ .04
" French	.06¼	@ .06¾

Australian Transcontinental Railway.—The completion of the Survey of the Palmerston and Pine Creek Railway is the first step towards the commencement of the Australian Transcontinental line from the northern end. It is announced than the next ministerial programme will comprise an Act for the construction of the whole line.